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1959/60

BULLETIN OF

WASHINGTON UNIVERSITY

SAINT LOUIS

THE SCHOOL OF ENGINEERING

APRIL 15, 1959

WASHINGTON UNIVERSITY

ETHAN ALLEN HITCHCOCK SHEPLEY, A.B., LL.B., LL.D.
Chancellor of the University

All schools, except Medicine, Dentistry, and Nursing, are located on the Main Campus at Lindell and Skinker Boulevards, St. Louis 5, Mo.

THE COLLEGE OF LIBERAL ARTS—Thomas S. Hall, Ph.D., Dean

Courses in the humanities, the social studies, and the natural sciences, leading to a Bachelor of Arts degree; curricula for prospective teachers; work leading to the Bachelor of Music degree; preprofessional studies for students who plan to enter the professional schools of Business and Public Administration, Law, Medicine, Dentistry, Social Work, the Graduate School of Arts and Sciences, the School of Botany, and advanced work at this and other universities and colleges.

THE SCHOOL OF ENGINEERING—Don Albert Fischer, B.S., LL.B., Dean

The Sever Institute of Technology—Gustav Mesmer, Ph.D., Director

Four-year prescribed course of study leading to the degree of Bachelor of Science in each of the following branches: Architectural, Chemical, Civil, Electrical, Geological, Industrial, Mechanical, and Metallurgical Engineering, Engineering Physics, and Engineering Science. Provision is also made for alumni to qualify for the professional degree of Engineer in each of the engineering branches.

Through the Sever Institute of Technology, graduate instruction leading to the degrees of Master of Science in Engineering, Master of Engineering Administration, and Doctor of Science in Engineering.

THE SCHOOL OF ARCHITECTURE

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THE GEORGE WARREN BROWN SCHOOL OF SOCIAL WORK

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THE HENRY SHAW SCHOOL OF BOTANY

Henry N. Andrews, Jr., Ph.D., Dean

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(Continued inside back cover)

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SAINT LOUIS

THE SCHOOL OF ENGINEERING

THE LIBRARY OF THE
JUL 2 3 1959
UNIVERSITY OF ILLINOIS

APRIL 15, 1959

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CALENDAR

1959

JANUARY

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1960

JANUARY

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CALENDAR 1959-60

FIRST SEMESTER

1959

SEPTEMBER

16, 17, 18 *Wednesday, Thursday, Friday.* Undergraduate Registration.

18 *Friday.* Orientation for all new students in the undergraduate divisions.

21 *Monday.* Classes begin.

28 *Monday.* Last day to file intention to graduate and diploma order for January, 1960.

NOVEMBER

16 *Monday.* Last day to withdraw from academic courses without prejudice.

25 *Wednesday.* Classes end.

26-29 *Thursday through Sunday.* Thanksgiving Recess.

DECEMBER

19 *Saturday.* Classes end.

20 *Sunday.* Christmas Recess begins.

1960

JANUARY

3 *Sunday.* Christmas Recess ends.

4 *Monday.* Classes resume.

16 *Saturday.* Classes end.

18-25 *Monday through Monday.* Final Examinations.

SECOND SEMESTER

February

1, 2 *Monday, Tuesday.* Undergraduate Registration.

3 *Wednesday.* Classes begin.

10 *Wednesday.* Last day to file intention to graduate and diploma order for June, 1960.

March

25 *Friday.* Last day to withdraw from courses without prejudice.

26 *Saturday.* Classes end.

27 *Sunday.* Spring Recess begins.

April

3 *Sunday.* Spring Recess ends.

4 *Monday.* Classes resume.

May

21 *Saturday.* Classes end.

23-30 *Monday through Monday.* Final Examinations.

30 *Monday.* Memorial Day, holiday (except for necessary examinations).

June

6 *Monday.* Commencement.

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Allen Noel Wollscheidt, M.S.E.E.....*Instructor in Electrical Engineering*
James H. Wood, B.Arch., A.E.[5].....*Visiting Lecturer in Civil Engineering*
Ernest Neall Wright, B.Arch.....*Associate Professor of Architecture*
John Zaborszky, Dpl. Ing., D.Sc.....*Professor of Electrical Engineering*

John Edmund Senne, M.S.M.E.
Associate Professor of Engineering Drawing
Washburne Denning Shipton, M.S.....*Associate Professor of Geology*
Franklin Buckley Shull, Ph.D.....*Associate Professor of Physics*
Eric Wilburn Smith, B.S.[5].....*Visiting Critic in Architecture*
Henry H. Schloss, Ph.D.....*Assistant Professor of Economics*

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[1] On leave of absence 1958-59.
[2] On leave of absence first semester 1958-59.
[3] On leave of absence second semester 1958-59.
[4] First semester 1958-59 only.
[5] Second semester 1958-59 only.
[6] November 20, 1958, to March 31, 1959.
[7] To March 31, 1959.
[8] To February 28, 1959.

ASSISTANTS

Merlin Walter Barth, B.S.E.E.....*Electrical Engineering*
Rodger Lee Berger, B.S.....*Mechanical Engineering*
Tsong-how Chang, M.S.....*Industrial Engineering*
Allen Oliver Clark, B.S.[1].....*Mechanical Engineering*
Edward G. Cristol, M.S.E.E.[2].....*Electrical Engineering*
Charles Stephen Ellis, B.S.....*Chemical Engineering*
John P. Grynkiewicz, B.E.S.....*Chemical Engineering*
David Carl Hagen, B.S.....*Chemical Engineering*
Charles Philips Harris, B.S.M.E.....*Mechanical Engineering*
Robert Albert Heidemann, B.S.....*Chemical Engineering*
Edward L. Merkle, B.S.....*Chemical Engineering*
John Jacob Meyer.....*Mechanical Engineering*
Charles Lafayette Proctor, M.S.M.E.....*Mechanical Engineering*
Stanley Irving Proctor, Jr., B.S.....*Chemical Engineering*
Barry Lucas Reeves, M.S.M.E.....*Mechanical Engineering*
Theodore Goodwin Smith, B.Eng.S.....*Chemical Engineering*
S. Tiangco Tengonciang, Jr., B.S.C.E.....*Civil Engineering*
Wesley Walter Verges.....*Mechanical Engineering*
Sanwar Mal Verma, B.E.[3].....*Mechanical Engineering*
Cheng-Hua Wang.....*Mechanical Engineering*

COMMITTEES AND COUNCIL OF THE FACULTY OF THE SCHOOL OF ENGINEERING (1958-59)

Academic Policy

Dean Fischer; Assistant Dean Senne; Professors Andrews, Armstrong, Burbank, Condon, Grant, Hinchey, Kippenhan, Koopman, Mesmer, Nadler.

Honors

Professor Mesmer; Professors Armstrong, Brielmaier, Gulbransen.

Student Advisory Council

Professor Hundley; Professors Brust, Cleaves, Esterson, Fisher, Gulbransen, Holsen, Marsh, Ong, Ryckman, Sard; Messrs. Govro, Greenberg, Gregory, Harper, Lance, Ozment, Reaves, Scheuner, Wann.

Dean's Advisory Committee on Tenure

Professor Honnell; Professors Brust, Holladay.

Discipline Committee

Professor Diboll; Professors Marsh, Zaborszky.

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[1] Second semester 1958-59 only.
[2] December 1, 1958, to May 31, 1959.
[3] First semester 1958-59 only.

HISTORICAL STATEMENT

On February 22, 1853, at the instance of Wayman Crow, Esq., a member of the State Senate, the Legislature of Missouri granted a charter to an educational institution to be located in the city of St. Louis, and to bear the name Eliot Seminary, in honor of the Reverend William Greenleaf Eliot, of St. Louis.

The charter was to be perpetual, and no limitations were imposed, excepting those which forbade any sectarian or partisan instruction. At a meeting of the incorporators held on February 22, 1854, a change of name was proposed in deference to the wishes of Dr. Eliot. Washington Institute was suggested, because the charter had been granted on Washington's birthday and because the meeting of the Board of Directors was held on the same anniversary. Owing to objections which arose this name was not approved by the State Legislature at the time, but in 1857, by a change in the charter, the name became Washington University. It seemed to the founders that the name was significant of the character of the institution which they sought to found. The first Board of Directors was composed of seventeen well-known, public-spirited citizens of St. Louis, who were named in the charter and given the power to fill vacancies in their number caused by death or resignation.

The O'Fallon Polytechnic Institute, one of the first educational activities established under the University charter of 1853, initiated the technical instruction which, on a much more extensive and intensive scale, is now given in the Schools of Engineering and Architecture.

The School of Engineering appears under this name for the first time in the University catalogue of 1867-68, where it is announced as offering instruction in Civil and Mechanical Engineering. Instruction in Chemistry from the industrial point of view, which later developed into the present course of study in Chemical Engineering, was first given in 1870. Mining Engineering was added in 1871, but was discontinued in 1892. Electrical Engineering, developed as an offering of physics, was taught as early as 1886, but became a separate department in 1901. Curricula in Industrial Engineering and Geological Engineering were established in 1935 and 1938, respectively.

Washington University is a member of the Association of American Universities, the Association of Urban Universities, the Association of American Colleges, the Missouri College Union, and the North Central Association of Colleges and Secondary Schools. Curricula in the School of Engineering are accredited by the Engineers' Council for Professional Development.

FOREWORD

Engineering education becomes increasingly important with every development in science and with each new application of science to industrial processes. The student engineer must learn the fundamentals of science through the study of mathematics, physics, chemistry, and engineering principles. At the same time he should be introduced to recent developments within one or more special fields. He must also learn not only some of the techniques of industry, but the economic and social bases upon which they rest. In his training, therefore, he should acquire, along with knowledge and skill that lead to professional competence, the ability to think clearly, to lay out and carry through precise plans, and to appreciate the social and economic significance of an engineer's work in the world of today. Only on such broad lines can the engineer be fitted to take his part as a responsible member of this growing and powerful profession.

ORGANIZATION

The School of Engineering provides instruction on the undergraduate level in Architectural, Chemical, Civil, Electrical, Geological, Industrial, Mechanical, and Metallurgical Engineering, Engineering Physics and Engineering Science.

The undergraduate curricula leading to the degree of Bachelor of Science have been planned in accordance with the following considerations: a thorough grounding in fundamentals and the development of clear thinking and accurate expression; the inclusion in each curriculum, as a common core, of those subjects in which fundamental principles are developed; the elimination of extreme specialization in subjects that are better learned in actual practice; and offering electives in the fourth year so that students may pursue studies of nonprofessional character in the areas of their added interests.

The Sever Institute of Technology offers graduate instruction leading to the Degree of Master of Science in Engineering, in the Departments of Chemical, Civil, Electrical, Geological, Industrial, Mechanical, Metallurgical, and Sanitary Engineering, in Applied Mechanics, and in Engineering Administration. Programs of study leading to the degree of Doctor of Science in Engineering[1] are currently offered by the Departments of Chemical, Civil, Electrical, Industrial, and Mechanical Engineering, and Applied Mechanics.

[1] Candidates for the Doctor's degree who prefer the Ph.D. degree will register in the Graduate School of Arts and Sciences.

ADMISSION AND REGISTRATION

Candidates for admission to the School of Engineering should make application to the Dean of Admissions, Washington University, St. Louis 5, Missouri.

The Office of the Dean of Admissions will supply the student with the necessary application forms and such other information as may be required. The office is located in Room 127 of Robert S. Brookings Hall.

Students who enter the School of Engineering in February should plan to attend Summer School at the end of their first semester and take such courses as will advance their standing in mathematics so as to maintain proper prerequisite sequences. In any case they should consult with their department head before enrolling for courses.

ADMISSION TO THE FRESHMAN CLASS

General Qualifications

The primary considerations for admission to Washington University are the student's intellectual promise, the quality of his academic achievement, and his potentialities for becoming a useful citizen. All applicants for admission (1) must be certified graduates of a fully accredited secondary school, public or private, or be currently enrolled in such a school for the graduation certificate; they (2) must present the proper distribution of high-school subjects, as described below; and they (3) must be recommended by the Principal or Headmaster of their secondary school. The right is reserved to restrict admission to those students of good moral character who present the best evidence of being able to profit from college studies at Washington University.

Seven Important Steps

There are, in general, seven important steps to be observed carefully by students applying for admission to the freshman class. These steps need not necessarily be followed in the order in which they are given below, but they are all to be regarded as essential to the admission process. Applicants should be certain, therefore, that they:

1. Secure from the Office of the Dean of Admissions the two parts of the application form.

2. Observe that the application form is in two parts, designated as follows: (a) Part I—General Information, and (b) Part II—Secondary School Record and Principal's Report.

3. Fill in Part I of this form and return it to the Office of Admissions.

4. Refer Part II of this form to the Principal or Headmaster of their

secondary school, and request that it be filled in and then mailed direct to the Office of Admissions.

5. Secure from the College Board authorities, or from the appropriate official of their secondary school, the application to take the Scholastic Aptitude Test of the College Entrance Examination Board.

6. Take this Scholastic Aptitude Test in December, January, February, or March of their senior year in secondary school; or, if they should so prefer, in March or May of their junior year.

7. Request the College Entrance Examination Board to send a report of their test scores to the Dean of Admissions, Washington University, St. Louis 5, Missouri.

Entrance Examination

All applicants for admission to the freshman class are asked to take the Scholastic Aptitude Test of the College Entrance Examination Board. The Scholastic Aptitude Test consists of a Verbal Section and a Mathematical Section, and is given during the Morning Session of the Board tests. The fee for this test is $7.00, payable to the College Entrance Examination Board. As the name indicates, the Scholastic Aptitude Test is a test of the candidate's aptitude for college studies. It calls for no special preparation other than that which college-bound students receive in the regular classwork of their secondary school.

Applicants make all arrangements for taking the Scholastic Aptitude Test direct with the College Board authorities. Students who live in the Middle West, the South, or the East, should address their inquiries to the College Entrance Examination Board, Box 592, Princeton, New Jersey. Students living in New Mexico, Colorado, Wyoming, and Montana, and other states to the west, should address their inquiries to the College Entrance Examination Board, Box 27896, Los Angeles 27, California.

Applicants should ask the College Board to send them a copy of the *Bulletin of Information*, which is obtainable from the Board without charge. It is, of course, possible that the applicant's secondary school may have a supply of these bulletins on hand for distribution upon request. This *Bulletin of Information* contains, among other things, an application blank for taking the test, facts relative to test rules and procedures, and a complete list of the centers where College Board tests are given throughout the country.

Dates of Entrance Examination

Requests to take the Scholastic Aptitude Test of the College Entrance Examination Board should be received by the College Board well in advance of the date on which the test is scheduled to be given. Applications received later than three weeks before each test date in Decem-

ber, February, and August, and four weeks before each test date in January, March and May, are subject to a penalty fee of $3.00 in addition to the regular fee of $7.00. The schedule of tests and penalty dates is as follows:

Test date	*Penalty date*
Saturday, May 16, 1959	April 18, 1959
Wednesday, August 12, 1959	July 22, 1959
Saturday, December 5, 1959	November 7, 1959
Saturday, January 9, 1960	December 12, 1959
Saturday, February 6, 1960	January 9, 1960
Saturday, March 12, 1960	February 13, 1960
Saturday, May 21, 1960	April 23, 1960

Candidates are urged to send in their applications and fees as early as possible, preferably at least several weeks before the penalty date, since early registration allows time to clear up possible irregularities which might otherwise delay the issuing of reports. In general, applications received at a Board office later than two weeks prior to the date of the examination cannot be guaranteed acceptance.

Early Filing of Credentials Urged

Students are encouraged to submit, early in their seventh semester of secondary school, their application for admission and the transcript of their high school record. Applicants are also urged to take the Scholastic Aptitude Test of the College Entrance Examination Board on the earliest convenient date: that is, in December, January, February, or March of their senior year in secondary school; or, if they should so prefer, in March or May of their junior year. Primary importance is attached to the applicant's rank in class, the pattern of high school studies, the recommendation furnished by the Principal or Headmaster of the secondary school, the selection of courses for the senior year, and the score made by the applicant on the Scholastic Aptitude Test.

In general, students who take the Scholastic Aptitude Test in the March or May of their junior year in secondary school do so for purposes of guidance and counseling or for the experience that is always to be gained from practice. Whenever they wish to do so, however, all such students may have a report of these scores sent to our Admissions Office. When scores on tests taken in the junior are found to be satisfactory, the applicants will be so notified and will not, for purposes of admission, need to take the test again in their senior year. Applicants for scholarships, however, may find it in their best interest to take the test in December, January, or February of their senior year, even though they may have taken it earlier, since they will be given the benefit of the

higher score, whether it be that of the junior year or that of the senior year. This same arrangement of giving the student the benefit of the higher score applies to those seeking admission as well as to those applying for a scholarship.

Washington University follows the policy of notifying students of the action taken on their applications just as soon as all the necessary credentials have been received. For purposes of early notification of acceptance, an application for admission to the freshman class is considered complete when the Office of Admissions has on file the following credentials: (a) Part I of our application blank, (b) Part II of our application blank, and (c) the report of the applicant's score on the Scholastic Aptitude Test of the College Board. Our policy of early announcement of action taken means that qualified applicants may expect to be notified of their acceptance by Washington University as early as their seventh semester of secondary school. This early notification of acceptance assumes a continuation of work of good quality and graduation from secondary school as planned.

Entrance Subjects and Units

The chief emphasis in studies preparatory for engineering should be placed upon a mastery of English, mathematics, and the laboratory sciences. Preference will be given to those applicants who present a program of high-school studies distributed as follows:

4 units of English, with as much practice as possible in writing;

4 units of mathematics, including 2 units of algebra, 1 unit of plane geometry, ½ unit of trigonometry, and ½ unit of solid geometry;

2 units of laboratory sciences, preferably physics and chemistry; and

5 units of electives, preferably from the fields of social studies, foreign language, science, or industrial arts.

Secondary-school graduates with outstanding records, but with slight deviations from the program of studies as recommended above, may be considered for admission on an individual basis. The minimum requirements for consideration are the following: 3 units of English; 3 units of mathematics, including 1½ units of algebra, 1 unit of plane geometry, and ½ unit of trigonometry or solid geometry, preferably trigonometry; 1 unit of a laboratory science, preferably physics or chemistry; 1 unit of social studies; and 7 additional units selected from these fields or from other subjects normally accepted toward graduation from a fully accredited secondary school.

ADMISSION WITH ADVANCED STANDING

Candidates who have completed some college work elsewhere are invited to apply for admission either to the Fall Semester or the Spring Semester. In general, the first selection of transfer students for the Fall Semester is made in April, and the first selection of transfer students for the Spring Semester is made in November. An early filing of applications is strongly recommended.

Students admitted from institutions of equal standing with Washington University are given full credit for all work satisfactorily done in such institutions and equivalent to work accepted for graduation in this University. From junior colleges accredited by a duly authorized agency, students are admitted to advanced standing under the same conditions. In general, an applicant must have maintained an average intermediate between C and B in work previously taken. The right is reserved to refuse credit in subjects in which the applicant has received grades of D or the equivalent. In all cases, whatever advanced standing is given is contingent upon the quality of the work done in this University, and is subject to revision and reduction if the work of the student indicates the necessity for such action. No student admitted from another institution will be recommended for the Bachelor's degree until a full year's work has been completed in the School of Engineering, and this work, save under exceptional circumstances, must be that which regularly belongs to the senior year.

Students who apply for admission with advanced standing should arrange with the registrar of each institution previously attended, including any attended during the summer sessions, to send to the Dean of Admissions, Washington University, St. Louis 5, Mo., a transcript of their record regardless of whether or not the transcript of the last institution lists the record of institutions previously attended and regardless of whether or not credit was received for the courses in which they were enrolled. The transcript from the institution last attended must show all courses which are currently in progress and must contain a statement of honorable dismissal. All credentials must be received in ample time for processing, and they become the property of the University.

STUDENTS NOT CANDIDATES FOR A DEGREE

In certain instances and when conditions permit, the School of Engineering considers the admission of candidates who apply for entrance in the category of students not candidates for a degree. The students under this heading are those who, by reason of maturity or experience, are qualified to pursue certain courses of study, but who do not have the opportunity to pursue the curriculum in full.

Applicants for admission as students not candidates for a degree must make written application to the Dean of Admissions, stating their reasons for wishing to be special students. Applicants may not be admitted without approval by the Office of the Dean of Admissions, by the Office of the Dean of the School of Engineering, and by the instructor of the course requested.

Students not candidates for a degree are subject to all rules applying to regular students, including the refund policies with regard to complete and partial withdrawals. Those who elect fewer than three full courses are required to maintain a grade of at least C in each course. The residence of all such students will be promptly terminated should it appear at any time that the privileges accorded them by admission are not being used to the best advantage.

VETERANS

All inquiries relating to educational benefits under the Veterans Administration should be addressed to the Office of the Veterans Adviser, Room 16, Cupples I. Students who will be using these benefits for the first time at Washington University are urged to make arrangements with the Veterans Administration for the proper authorization as early as is possible.

Benefits under the Korean G.I. Bill do not include payment of tuition to the college or university. Korean veterans confronted with financial difficulties are invited to confer with the Veterans Adviser regarding the University's deferred tuition plan.

REGISTRATION

Registration for the First Semester of 1959-60 will begin on Wednesday, September 16, and extend through Friday, September 18, 1959. Detailed instructions for registration and the registration materials will be mailed to all undergraduate students, formerly enrolled or newly admitted, whose programs for the succeeding semester have been approved by the Office of the Dean. Students who do not receive their materials at least a week before the registration dates should consult the Office of Student Records.

Registration for the Second Semester of 1959-60 will be held on Monday, February 1, and Tuesday, February 2.

Late Registration

Students who fail to register and pay their fees at the time for which they are scheduled are required to pay a fee of $5.00.

COURSES OF STUDY AND DEGREES

FOUR-YEAR CURRICULA LEADING TO THE B.S. DEGREE

Complete synopses showing in detail the work prescribed in the curricula in Architectural, Chemical, Civil, Electrical, Geological, Industrial, Mechanical, and Metallurgical Engineering, Engineering Physics, and Engineering Science are given on pp. 28 ff. and descriptions of the individual courses of instruction will be found on pp. 53 ff. The degree of Bachelor of Science is conferred upon the satisfactory completion of one of the prescribed curricula in its entirety.

Electives specified in the programs of the several departments may be chosen, subject to the approval of the head of the department in which the student is registered, from courses listed on pp. 63-64, or from courses offered in the College of Liberal Arts, the School of Business and Public Administration, and the School of Architecture. In all cases the student must be able to satisfy the prerequisites of the courses elected, and the choice must be made in accordance with a systematic plan.

PROFESSIONAL DEGREES

The professional degrees of Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Geological Engineer, Industrial Engineer, and Mechanical Engineer may be conferred upon graduates of the School of Engineering of Washington University who comply with the requirements described below, subject to the approval of the Committee on Academic Policy.

Requirements

(a) The candidate must be a graduate of Washington University with a baccalaureate degree in engineering.

(b) He must have at least eight years of professional experience since graduating with the baccalaureate degree, of which at least four years must be in responsible charge. Responsible charge, as used in this section, means individual professional responsibility for important work in engineering.

(c) He must submit the names of three references who are familiar with his professional career covering the period since graduation.

(d) He must apply for admission to candidacy not later than December 1 of the academic year in which the degree is to be conferred. The degree will not be conferred in absentia.

(e) Admission to candidacy is to be judged by an Admission Com-

mittee appointed by the Dean, consisting of one member from each department of the School of Engineering. A unanimous decision of this Committee is required before a man is accepted for candidacy.

(f) After admission, the candidate must submit a thesis, written to conform to the Directions for Writing of the Professional Thesis, a copy of which can be secured from the office of the Dean of the School of Engineering; or he may substitute a collection of published articles of a professional nature. The thesis or the collection of published articles must be reviewed and approved by unanimous decision of the Examining Committee.

(g) The Examining Committee is to be appointed by the Dean and is to consist of not less than five men, two of whom are to be competent practicing engineers in the field of the candidate and not members of the faculty. The other members of the Examining Committee are to be selected from the faculty.

(h) The thesis or collection of published articles must be submitted to the Examining Committee five weeks before the date of the Commencement at which the candidate expects to receive the degree.

(i) After the Examining Committee has reviewed and approved the thesis, the candidate will conduct a seminar on the general subject of the thesis (or of the published articles) before this Committee.

Fees

Every candidate for a professional degree is required to register immediately after his admission to candidacy and to pay a fee of $25.00. An additional fee of $25.00 is due and payable after the acceptance of the thesis and before the Commencement at which the degree is to be conferred. A diploma fee of $5.00 is also payable before Commencement.

GENERAL REGULATIONS

STUDENT CONDUCT

Students are expected to conduct themselves so as to reflect no discredit on themselves or the University. The registration of any student in the University will be cancelled if, in the opinion of the University authorities, his further presence is not conducive to the best interests of the University. In such cases of cancellation a prorata refund of tuition will be made.

UNITS, GRADES, AND GRADE POINTS

A credit unit is the equivalent of one recitation or lecture hour a week for one semester, or of one laboratory or drawing room period of two hours and thirty minutes a week for one semester.

The work of students is rated in terms of the following system of grades and grade points:

A (Superior) carries 3 grade points per credit unit.

B (Very good) carries 2 grade points per credit unit.

C (Fair) carries 1 grade point per credit unit.

D (Unsatisfactory but passable) carries no grade points per credit unit.

F (Failure) carries no grade points per credit unit, and the course must be repeated.

GRADES OF I AND X

The grade I (incomplete) indicates that the work of a student has been generally acceptable, but that because of illness or other unavoidable cause certain requirements have not been met. The grade of X is recorded when a student is absent from a midyear or final examination because of illness or other unavoidable reason, provided his work has been otherwise satisfactory.

Grades of X and I must be removed not later than the close of the next full semester a student is in residence. On failure so to make up an X or I, the student cannot receive credit for the course unless explicitly excused by the office of the Dean.

HONORS

In order to encourage scholarship two distinct forms of Honors are awarded during the student's course: Sophomore Honors, conferred at the end of the second year; and Final Honors, conferred at graduation. Students to whom Honors are awarded receive special certificates.

REQUIREMENTS FOR GRADUATION

Each candidate for a B.S. degree must complete all of the courses of study prescribed in the curriculum of the department in which he is enrolled, and unless specifically excused by the Chancellor, must be present at the Commencement exercises at which the degree is to be conferred. He must have earned grade points at least equal to the number of credit units he has attempted in his course of study, and he must not have received grades below C in more than one-fourth of the total number of credit units in his course of study, nor in more than 15 credit units of third-year and fourth-year subjects in the particular department in which the degree is sought.

Statement of Intention to Graduate

Every candidate for a B.S. degree must indicate his intention to graduate by filing a Diploma Order with the Director of Student Records not later than the end of the first week of the semester in which the degree is to be conferred. Forms for this purpose may be obtained from the Office of Student Records, Room 126, Brookings Hall.

The Dean's office has no official knowledge of the expected date of graduation of a given student until he files his "Intention to Graduate." It therefore becomes the responsibility of an individual student to see that he has satisfied or will satisfy all course and grade requirements prescribed for the degree desired. In all cases of irregularities the student is urged to contact the Dean's office at once for a ruling.

PROBATION AND GENERAL DEFICIENCY

Students whose work is of unsatisfactory character are placed on academic probation. If the record is not sufficiently improved after a reasonable time, probation is followed by dismissal for general deficiency. The regulations governing probation and general deficiency are as follows:

1. At the close of each semester the record of each student is computed in terms of the quotient of the total grade points earned during the semester over the total number of credit units attempted in that semester; at the same time there is computed the quotient of the cumulative total of grade points over the cumulative total of credit units attempted. The computations are made on the basis of the grade-point scale indicated on the preceding page. The ratios tabulated below then determine the actions indicated.

Action	Semesters in attendance									
	1	2	3	4	5	6	7	8	9	10
(1) Drop if record includes one or more F's and if ratio is	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(2) Probation if semester ratio is below	0.50	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.75
(3) Probation if cumulative ratio is below	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00
(4) But not if present semester rating is above	0.50	0.75	1.00	1.10	1.30					

Item (1) eliminates at once the student who completely neglects his work. Item (2) places on probation a student whose semester rating falls below a specified minimum (which is stepped up after the first year). Item (3) determines an ascending scale of cumulative performance; while (4) provides for cases in which the cumulative record is below normal, but where improved current performance warrants special consideration.

2. At the close of each semester the Dean's office examines the record of performance of every student and, according to the sliding scale above, informs those who will be on probation the following semester.

3. Any student who has earned grades which place him on probation for two consecutive or any three semesters will be considered not eligible to reregister and will be so notified.

4. A student who fails the same course twice will not be eligible to reregister.

5. Those who become ineligible to reregister for either of the above reasons may, if they desire to continue, present a written statement setting forth the reasons why they feel their situation should be reconsidered. This statement should be addressed to the Committee on Academic Policy and forwarded through the student's department head. A ruling will be handed down by the Dean's office.

ABSENCE RULE

Regular attendance at all class meetings is expected of each student. If, in the opinion of the instructor, any student has accumulated absences to such an extent as to preclude the possibility of satisfying the course requirements, the student's registration in that course will be cancelled, subject to the approval of the Dean.

WITHDRAWALS AND COURSE CHANGES

Withdrawals

Any student who, for any reason whatsoever, wishes to withdraw from the School of Engineering before the end of a semester should consult the Office of the Dean in person, so that a notation of the withdrawal

may be sent to the other offices concerned and so that the record of his work may be clear and complete. No such withdrawal will be official until the student deposits in the Office of the Dean a written request for withdrawal and until that request has been approved by the Dean. All veterans whose tuition is being paid by the government should, for their own protection, report also to the Veterans' Training Officer if they withdraw from the School of Engineering during or at the end of a semester. For schedule of refunds, see the section on Financial Regulations.

Course Changes

Any student who wishes to withdraw from an individual course or to change his enrollment from one course to another must have the express permission of the Dean's Office. In general, a student may not change from one course to another or withdraw from a course after his registration material has been checked by and deposited with the final checking clerk, but when a change or withdrawal is permitted, the student will be required to pay a fee for making the change; an exception will be made if the situation causing the change is clearly beyond the control of the student.

Upon demonstrating a valid reason to the Dean, a student may withdraw from a course before the stated deadline without prejudice. After the deadline he may withdraw without prejudice only if his grade at the time of withdrawal is C or higher; if it is below C, he will normally receive an F for the course and the grade will be used in determining his grade-point average. In the fall term the last date for withdrawal without prejudice will be November 16, 1959, and in the spring term March 25, 1960.

DEPARTMENT ANNOUNCEMENTS AND CURRICULA

ARCHITECTURAL ENGINEERING

The curriculum in architectural engineering prepares the student in those phases of professional practice which are concerned with the design and selection of the structural details of buildings, and at the same time stresses the close relation between aesthetic architectural design and the constructional requirements. The curriculum emphasizes the theoretical and practical knowledge of those basic principles of civil, mechanical, and electrical engineering which are applicable to architectural construction. The purpose of the curriculum is to make the architectural engineer a helpful collaborator of the architect; hence it includes essential training in the artistic phases of architectural design.

SYNOPSIS OF CURRICULUM IN ARCHITECTURAL ENGINEERING

First Year

SUBJECT	COURSE	Units *1st Sem.*	*2nd Sem.*
English	E Comp 101-102	3	3
College Mathematics	Math 115-116	5	5
Architectural Graphics	Arch 331-332	3	3
Elementary Surveying	Civ Eng 211		3
Physics	Phys 220		2
General Inorganic Chemistry	Chem 111	4	
Introduction to Architecture	Arch 101-102	2	2
Physical Education 101-102, Air or Military Science 101-102, or Band		1	1
	Total	18	19

Second Year

SUBJECT	COURSE	Units *1st Sem.*	*2nd Sem.*
Calculus	Math 215-216	4	4
Statics	AM 203	3	
Mechanics of Materials	AM 250		3
Direct and Alternating Circuits	Elec Eng 298		2
Physics	Phys 221-222	4	4
Elementary Design	Arch 311-312	5	5
History of Architecture	Arch 427	3	
Physical Education 201-202, Air or Military Science 201-202, or Band		1	1
	Total	20	19

THIRD YEAR

SUBJECT	COURSE	UNITS *1st Sem.*	*2nd Sem.*
Concrete Mixes	Civ Eng 340	2	
Framed Structures	Civ Eng 341	3	
Materials of Construction and Working Drawings	Arch 433-434	3	3
Engineering Materials	Civ Eng 337	3	
Direct and Alternating Current Machinery	Elec Eng 299	2	
Geology	Geol 101		3
Structural Steel Design	Civ Eng 354		3
Reinforced Concrete Design	Civ Eng 356		3
Engineering Economy	Ind Eng 310	3	
Hydraulics	Civ Eng 338		3
History of Architecture	Arch 428		3
Elective		3	
	Total	19	18

FOURTH YEAR

SUBJECT	COURSE	UNITS *1st Sem.*	*2nd Sem.*
Civil Eng. Design	Civ Eng 355-358	3	3
Specifications	Arch 645	2	
Indeterminate Structures	Civ Eng 405-406	3	3
Foundations	Civ Eng 464		3
Soil Mechanics	Civ Eng 419	3	
Sanitation	Arch 444		1
Air Conditioning	ME 382		3
Electives		6	
Ultimate Design	Civ Eng 407		1
Contracts & Specifications	Civ Eng 386		3
	Total	17	17

CHEMICAL ENGINEERING

Chemical engineering deals with the conduct and development of manufacturing processes in which chemical or physical changes of materials are involved. These processes may usually be resolved into a co-ordinated series of unit physical operations and unit chemical processes. The work of the chemical engineer is concerned primarily with the design, construction, and operation of equipment and plants in which a series of these unit operations and processes is necessary. Chemistry, physics, and mathematics are the underlying sciences of chemical engineering, and economics its guide in practice.

The curriculum in chemical engineering outlined below offers a well-organized, oriented program of study. It provides adequate training in the fundamentals of mathematics, chemistry, physics, and chemical engineering. Professional courses in chemical engineering are begun the first semester of the second year and serve to emphasize the engineering phases of the subject.

This curriculum is especially designed to prepare young men to accept employment as Junior Chemical Engineers, without previous industrial experience, in such fields as production, research, development, technical sales, and design. It also provides excellent preparation for graduate work leading to advanced degrees. The almost unprecedented growth of chemical industry during the past three decades has created an unusual demand for young men trained in the fundamental subjects prescribed in this curriculum.

SYNOPSIS OF CURRICULUM IN CHEMICAL ENGINEERING

FIRST YEAR

SUBJECT	COURSE	HOURS PER WEEK *1st Sem.* REC.	*1st Sem.* LAB.	*2nd Sem.* REC.	*2nd Sem.* LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	G E D 111	1	6		
General Inorganic Chemistry	Chem 111	2	6		
Qualitative Analysis	Chem 112			2	6
Physics	Phys 220			2	
Nontechnical Elective				3	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	15	9

Second Year

Subject	Course	Hours per Week 1st Sem. Rec.	1st Sem. Lab.	2nd Sem. Rec.	2nd Sem. Lab.
Calculus	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Quantitative Analysis	Chem 241	2	6		
Organic Chemistry	Chem 254			3	6
Inorganic Technology	Chem Eng 213	3			
Chemical Engrg Stoichiometry	Chem Eng 214			3	
Speech	Speech 211	3			
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	15	12	13	12

Third Year

Subject	Course	Hours per Week 1st Sem. Rec.	1st Sem. Lab.	2nd Sem. Rec.	2nd Sem. Lab.
Physical Chemistry	Chem 421-422	3		3	
Unit Operations I, II	Chem Eng 341-342	3		3	
Chemical Engineering Lab. I	Chem Eng 344				6
Thermodynamics	Chem Eng 352			3	
Circuits and Machinery	Elec Eng 298-299	2		2	
Engineering Economy	Ind Eng 310			3	
Differential Equations	Math 311	3			
Statics and Dynamics	AM 201	4			
Elective		3		3	
	Total	18		17	6

Fourth Year

Subject	Course	Hours per Week 1st Sem. Rec.	1st Sem. Lab.	2nd Sem. Rec.	2nd Sem. Lab.
Unit Operations III	Chem Eng 441	3			
Chemical Engineering Lab. II, III	Chem Eng 443-444		6		6
Instrumentation and Control	Chem Eng 435	2	3		
Organic Technology	Chem Eng 432			3	
Chemical Engineering Design	Chem Eng 462			3	3
Electronics	Elec Eng 348	3			
Electrical Laboratory	Elec Eng 336		3		
Descriptive Geometry	GED 112			1	6
Mineral Resources	Geol 365			3	
Elective[1]		6		3	
	Total	14	12	13	15

[1] Applied Mechanics 250, Mechanics of Materials, is strongly recommended as an elective.

CIVIL ENGINEERING

The specific purpose of the curriculum in civil engineering is to offer fundamental training in general and technical subjects which will best serve in a subsequent career in such enterprises as the design, construction, and operation of public works, important structures, and transportation facilities. Senior students may elect the Construction Option or they may choose the General Option.

The Construction Option is designed to train future executives for the construction industry. The fundamental design courses are combined with technical courses in the organization, planning, and administration of construction projects.

The General Option provides a system of elective courses so that a student has some opportunity to specialize, in his fourth year, in such lines of study as seem to him especially important, such as humanities, or certain more advanced technical courses.

St. Louis and surrounding communities provide unusual opportunities for students to observe the standard methods of procedure in a great variety of engineering operations concurrently with their technical studies. For the purpose of obtaining a more intimate knowledge of typical practice in the execution of engineering plans and projects, students are given definite encouragement to spend their summer vacations in positions in civil engineers' offices or upon works of construction.

SYNOPSIS OF CURRICULUM IN CIVIL ENGINEERING

FIRST YEAR

SUBJECT	COURSE	HOURS PER WEEK *1st Sem.* REC.	*1st Sem.* LAB.	*2nd Sem.* REC.	*2nd Sem.* LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	G E D 111	1	6		
Chemistry for Civil Engineers	Chem Eng 120			2	3
General Inorganic Chemistry	Chem 111	2	6		
Physics	Phys 220			2	
Elementary Surveying	Civ Eng 211			1	6
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	13	12

SECOND YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	Speech 211	3			
Calculus	Math 215-216	4		4	
Statics	AM 203	3			
Mechanics of Materials	AM 250			3	
Physics	Phys 221-222	3	3	3	3
DC & AC Circuits & Machinery	Elec Eng 298			2	
Engineering Surveys	Civ Eng 216	2	6		
Descriptive Geometry	GED 112			1	6
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	15	12	13	12

THIRD YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Concrete Mixes	Civ Eng 340			1	3
Highways and Airports	Civ Eng 336			3	
Engineering Materials	Civ Eng 337			2	3
Hydraulics	Civ Eng 338-348	3			3
Framed Structures	Civ Eng 341	3			
Structural Steel Design	Civ Eng 354			3	
Economics	Econ 211-212	3		3	
DC & AC Circuits & Machinery	Elec Eng 299	2			
Electrical Laboratory	Elec Eng 333		3		
Introduction to Dynamics	AM 299	2			
Thermodynamics	Mech Eng 323	3			
Photogrammetry	Civ Eng 220				3
Reinforced Concrete	Civ Eng 356			3	
Engineering Geology	Geol 367	2	3		
	Total	18	6	15	12

FOURTH YEAR—GENERAL OPTION

		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Structural Design	Civ Eng 355	1	6		
Foundations	Civ Eng 464			3	
Indeterminate Structures I	Civ Eng 405	3			
Hydrology	Civ Eng 451	3			
Contracts and Specifications	Civ Eng 386			3	
Professional Practice	Civ Eng 393	1			
Soil Mechanics	Civ Eng 419	2	3		
Sanitary Engineering Design	Civ Eng 485			2	3
Engineering Design	Civ Eng 358			1	6
Sanitary Engineering Science	Civ Eng 382	3			
Elective		3		6	
	Total	16	9	15	9

FOURTH YEAR—CONSTRUCTION OPTION

SUBJECT	COURSE	HOURS PER WEEK *1st Sem.* REC.	LAB.	*2nd Sem.* REC.	LAB.
Structural Design	Civ Eng 355	1	6		
Foundations	Civ Eng 464			3	
Sanitary Engineering Science	Civ Eng 382	3			
Engineering Design	Civ Eng 358			1	6
Indeterminate Structures I	Civ Eng 405	3			
Construction Methods, Estimates, and Costs	Civ Eng 471-472	2	3	2	3
Soil Mechanics	Civ Eng 419	2	3		
Contracts and Specifications	Civ Eng 386			3	
Professional Practice	Civ Eng 393	1			
Construction Cost Controls	Civ Eng 395	3			
Elective				6	
	Total	15	12	15	9

ELECTRICAL ENGINEERING

The curriculum in electrical engineering has been designed to provide broad basic education, from which it is expected that its graduates will find themselves equipped with the necessary fundamentals to work in any of the various divisions of the whole field of electrical engineering.

Facilities are offered for the experimental study of all types of electrical machines, radio and communication apparatus, electronic equipment, electrical instruments, servomechanisms, computers, transistors, etc.

The location of a number of prominent electrical manufacturing companies and large central stations in and around St. Louis provides opportunity for numerous inspection trips.

Analog computers containing linear and nonlinear elements, together with recording equipment, are available on which advanced seniors may have special problems solved.

Students planning to pursue the course in Electrical Engineering are urged to take the mathematics proficiency test which is given in April and September. In this way they may qualify to proceed directly to analytic geometry and calculus. Information concerning the placement test may be obtained by inquiry at the Office of the Dean, College of Liberal Arts.

Students who enter in February should plan to take such Summer School courses as will advance their standing in mathematics, thus permitting their graduation in a minimum of time. These students should consult with the head of their department before enrolling for courses.

Students who plan to continue their studies beyond the Bachelor's level are urged to take French or German and advanced mathematics as electives. See the Sever Institute Bulletin for general requirements for Master's and Doctor's degrees in Electrical Engineering.

SYNOPSIS OF CURRICULUM IN ELECTRICAL ENGINEERING

First Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	G E D 111	1	6		
Descriptive Geometry	G E D 112			1	6
General Inorganic Chemistry	Chem 111	2	6		
Engineering Materials	Chem Eng 110			3	
Elementary Mechanics	Phys 220			2	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	14	9

Second Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	Speech 211			3	
Calculus I and II	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Statics	AM 203	3			
Mechanics of Materials	AM 250			3	
Metal Machining	Mech Eng 210		3		
Direct-Current Circuits	Elec Eng 213	3			
Electrical Circuits Lab. I	Elec Eng 303		3		
Direct-Current Machinery	Elec Eng 307			2	
Direct-Current Machinery Lab.	Elec Eng 331				3
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	13	12	15	9

THIRD YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Elec., Dielec. & Magnetic Circuits & Fields	Elec Eng 314	3			
Electrical Circuits Lab. II	Elec Eng 305		3		
Alternating-Current Circuits	Elec Eng 321-324	3		3	
Kinetics	AM 303	3			
Thermodynamics	Mech Eng 323			3	
Applied Calculus	Math 312			3	
Electronics	Elec Eng 354			3	
Electronics Laboratory	Elec Eng 356				3
Group A Courses		3		3	
Differential Equations	Math 311	3			
Elective		3		3	
	Total	18	3	18	3

Group A Courses:

Economics	Econ 211-212
Economics	Econ 103-104
ROTC (third year)	
Engineering Economy	Ind Eng 310
Industrial Organization	Ind Eng 380
World Resources & Industries	Geog 315
Human Relations in Ind.	Ind Eng 411

FOURTH YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Alternating-Current Machinery	Elec Eng 401-402	3		3	
Alternating-Current Machinery Lab.	Elec Eng 361-362		6		6
Communication Engineering	Elec Eng 421	3			
Radio Engineering	Elec Eng 422			3	
Communication and Radio Lab.	Elec Eng 431-432		3		6
Electrical Circuits Lab. III	Elec Eng 405		3		
Transmission Line Theory	Elec Eng 450	3			
Engineering Law	Ind Eng 421			2	
Transients	Elec Eng 415	3			
Elective		3		6	
	Total	15	12	14	12

ENGINEERING PHYSICS

The curriculum in Engineering Physics is designed to take full advantage of the facilities of both the Physics and Electrical Engineering Departments in preparing students for junior positions in applied physics, while at the same time offering a foundation for further studies to those students who elect to pursue graduate work in physics. The first two years are similar to the electrical engineering curriculum, whereas the junior and senior years are devoted principally to the advanced undergraduate courses in physics and to selected electrical engineering courses in electric circuits and electronics. A strong sequence in mathematics is a feature of the entire curriculum.

It is expected that students electing Engineering Physics will adapt their curriculum to meet their needs through working closely with advisers in the Department of Physics and the School of Engineering.

SYNOPSIS OF CURRICULUM IN ENGINEERING PHYSICS

First Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	G E D 111	1	6		
Descriptive Geometry	G E D 112			1	6
General Inorganic Chemistry	Chem 111	2	6		
Elementary Mechanics	Phys 220			2	
Qualitative Analysis	Chem 112			2	6
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	13	15

Second Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	Speech 211			3	
Calculus	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Statics	AM 203	3			
Mechanics of Materials	AM 250			3	
Metal Machining	Mech Eng 210		3		
Welding	Mech Eng 305		3		
Language (German preferred)		3		3	
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	13	12	16	6

THIRD YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	1st Sem. LAB.	2nd Sem. REC.	2nd Sem. LAB.
Electricity	Phys 421-422	3		3	
Intermediate Lab. I & II	Phys 321-322	1	3	1	3
Mechanics	Phys 411	3			
Heat and Thermodynamics	Phys 412			3	
A-C Circuits I	Elec Eng 321	3			
Electronics	Elec Eng 354			3	
Electronics Laboratory	Elec Eng 356				3
Differential Equations	Math 311	3			
Advanced Calculus I	Math 413			3	
Elective		3		3	
	Total	16	3	16	6

FOURTH YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	1st Sem. LAB.	2nd Sem. REC.	2nd Sem. LAB.
Economics	Econ 211-212	3		3	
Optics	Phys 461	3			
Mechanics of Continuous Media	Phys 462			3	
Atomic, Nuclear, and Solid State Physics	Phys 471-472	3		3	
Experimental Techniques	Phys 451-452		6		6
Advanced Calculus II	Math 414	3			
Complex Variables	Math 416			3	
Elective*		3		3	
	Total	15	6	15	6

ENGINEERING SCIENCE

The curriculum in Engineering Science emphasizes the values of the basic courses in Mathematics, Physics, and Chemistry in connection with the basic engineering courses in Applied Mechanics, Electrical Engineering, and Mechanical Engineering. As in the curriculum in Engineering Physics, a strong sequence in mathematics courses is an essential part of the curriculum. The mathematics sequence scheduled for this curriculum at the freshman and sophomore level requires that the student be prepared above the average. The proficiency tests in mathematics for high school seniors are a requirement for admission to the freshman program in this curriculum. The engineering applications (Elasticity, Structures, Vibrations, Fluid Dynamics, Thermodynamics) will be based on these mathematical fundamental courses. This curriculum has been

* Physical Chemistry, Chemistry 421-422; Communication Engineering, Electrical Engineering 421; Radio Engineering, Electrical Engineering 422; Language.

established for students of special interest and ability in analysis, preparing them for professional work in research and development. The electives, partly technical and partly nontechnical, must be arranged in consultation with the adviser of this curriculum. Graduates in Engineering Science may continue on to graduate work in the different departments with a relatively short period of transition.

SYNOPSIS OF THE CURRICULUM IN ENGINEERING SCIENCE

First Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
Elementary Mechanics	Physics 220			2	
Engineering Materials	Met Eng 201	2			
Mathematical Anal. I	Math 117-118	5		5	
Engineering Drawing	GED 111	1	6		
Descriptive Geometry	GED 112			1	6
General Inorganic Chemistry	Chem 111-112	2	6	2	6
Physical Education, Air or Military Science 101-102, or Band			3		3
	Total	13	15	13	15

Second Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	Speech 211	3			
Mathematical Anal. II	Math 217	4			
Elementary Differential Equations	Math 311			3	
Statics	AM 203	3			
Mechanics of Materials	AM 250			3	
Physics	Physics 221-222	3	3	3	3
Direct Current Circuits	Elec Eng 213			3	
Electrical Circuits Lab. I	Elec Eng 303				3
Elective		3		3	
Physical Education, Air or Military Science 201-202, or Band			3		3
	Total	16	6	15	9

THIRD YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	1st Sem. LAB.	2nd Sem. REC.	2nd Sem. LAB.
Advanced Calculus	Math 413-414	3		3	
Kinetics	AM 303	3			
Mechanical Vibrations	AM 407			3	
Thermodynamics	Mech Eng 323	3			
Flow of Fluids	Mech Eng 370			3	
AC Circuits	Elec Eng 321-324	3		3	
Indeterminate Structures	Civ Eng 405	3			
Electronics	Elec Eng 354-356			3	3
Engineering Law	Ind Eng 421			2	
Elective		3			
	Total	18		17	3

FOURTH YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	1st Sem. LAB.	2nd Sem. REC.	2nd Sem. LAB.
Complex Variables	Math 416	3			
The Laplace Transform	Math 419			3	
Atomic, Nuclear and Solid State Physics	Physics 471	3			
Heat Transfer	Mech Eng 371	3	3		
Engineering Statistics	Ind Eng 301	3			
Engineering Economy	Ind Eng 310			3	
Electives*		6		12	
	Total	18	3	18	

GEOLOGICAL ENGINEERING

The curriculum in geological engineering has been designed to train students for those industrial and engineering fields of work in which a thorough knowledge of geology is essential; examples are to be found in petroleum exploration and production, mining geology, geophysics, industrial utilization of mineral resources, Federal and State Geological Surveys, and in enterprises involving foundations and the construction of dams. Its content is also sufficiently inclusive to prepare for immediate entry upon graduate work leading to the Master's and Doctor's degrees in Geology, Geological Engineering, or Geophysics.

The work in Geology is carried on in Newton R. Wilson Memorial Hall, especially designed and equipped for the purpose. The building contains a machine shop, photographic dark rooms, drafting rooms, materials preparation rooms, as well as technical laboratories supplied

* Consult adviser for recommended electives (technical and nontechnical).

with necessary apparatus and work materials. For advanced work there are available the various instruments employed in geologic field methods; X-ray, thermal analysis, and spectrographic apparatus; petrographic and binocular microscopes and other optical instruments; photographic and enlarging equipment; cutting, grinding, and polishing machines for the making of thin sections, polished ore specimens, and the cutting and polishing of gems; and various specialized pieces of apparatus used in other branches of study, some of which have been constructed in the departmental machine shop.

The Geology and Geography Library with a librarian in attendance, is located in the building. It contains approximately 13,200 volumes, as well as maps and periodicals covering the fields of geology and geography. Over 150 periodicals are received regularly and many of the sets are complete. The library receives regularly publications and maps pertinent to geology from various federal, state, and foreign surveys, bureaus of mines, and other organizations.

Opportunity for field study and inspection trips of great variety is afforded by the location of St. Louis in reference to many features of general geological interest—developing oil fields, important mining and quarrying operations in both ores and nonmetallic minerals, many industries utilizing mineral raw materials, and engineering works such as dams, foundations, and river control in which geology is a significant factor.

SYNOPSIS OF CURRICULUM IN GEOLOGICAL ENGINEERING

First Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	G E D 111	1	6		
Descriptive Geometry	G E D 112			1	6
General Inorganic Chemistry	Chem 111	2	6		
Qualitative Analysis	Chem 112			2	6
Physics	Phys 220			2	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	13	15

SECOND YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	Speech 211			3	
Calculus	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Surveying	Civ Eng 213	1	3		
Photogrammetry	Civ Eng 220				3
General Geology	Geol 101-102	2	3	2	3
Mineralogy and Petrology	Geol 231-232	2	3	2	3
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	12	15	14	15

THIRD YEAR		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Invertebrate Paleontology	Geol 322			2	3
Geology of Petroleum and Natural Gas	Geol 461	2	3		
Economic Mineral Deposits	Geol 466			2	3
Structural Geology	Geol 341	2	3		
Field Geology	Geol 344			2	3
Statics and Dynamics	AM 201	4			
Mechanics of Materials	AM 250			3	
Quantitative Analysis	Chem 241	2	6		
Metal Machining	Mech Eng 210				3
Exploration Geophysics	Geol 472			2	3
Economics	Econ 211-212	3		3	
	Total	13	12	14	15

FOURTH YEAR[1]		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Optical Mineralogy	Geol 431	1	6		
Petrography	Geol 434			1	6
Stratigraphy	Geol 421	2	3		
Engineering Materials	Civ Eng 337	2	3		
Hydraulics	Civ Eng 338-348			3	3
Physical Chemistry	Chem 421-422	3		3	
Electrical Machinery	Elec Eng 298-299	2		2	
Ground-Water Geology	Geol 465	2	3		
Geology Applied to Modern Construction	Geol 464			2	3
Elective				3	
	Total	12	15	14	12

[1] Attendance at a summer field school in Geology (six weeks) is required of a student before his senior year. Approved summer employment may be considered to meet this requirement.

INDUSTRIAL ENGINEERING

The curriculum in Industrial Engineering prepares the student for designing and improving systems, procedures, and methods in any type of industry. It also prepares the student for later advancement to positions of management and administration. It includes the fundamental courses in mathematics, chemistry, physics, and applied mechanics, as well as basic courses in chemical, mechanical, and electrical engineering and courses in human relations. The last mentioned courses provide needed training for industrial engineers because their work always involves activities with other people, management and workers. To do an effective job, an industrial engineer must know how to deal with people, how to get along with them, how to sell them ideas, and how to gain their respect and co-operation. Also, these courses encourage the philosophy that the engineer must be concerned with the social and economic effects of his technological advancements.

The Industrial Engineering curriculum is centered around a problem-solving discipline, and is designed to stress five broad areas: basic sciences, engineering science (statics, dynamics, thermodynamics, heat transfer, etc.), industrial engineering basic tools (statistics, mathematical programming, numerical computation, cost accounting, etc.), Industrial Engineering problem solving (such as work design, mechanization and process planning, and quality control), and humanities. Along with teaching the specific techniques required, most Industrial Engineering courses stress the need for co-operating with and assisting other engineering branches and management activities, such as designing machines for more effective use by the human being, developing better accounting procedures, assisting in product development, etc.

The facilities available to the department, in addition to laboratories of other departments, include a work design laboratory, plant layout and production control laboratory, UNOPAR laboratory, materials handling laboratory, well-equipped workshop, mechanization and process planning laboratory, statistical laboratory, special projection room, and graduate research areas and equipment. These facilities are used for undergraduate instruction and laboratories, and for development of new principles and application techniques for undergraduate instruction. Some of the most relevant developments from all research in the country as well have been related to the increasingly important concept of "automation" or the automatic factory. Industrial engineering practices are necessary for automation by reducing human skills required for performing work, by providing some basic designs for automatic production, by designing proper scheduling and control procedures, by working at all levels of the organization for the proper approach to and treatment of the human problem, etc. The use of department facilities for research has also

recently contributed to the introduction of electronics to industrial engineering techniques.

The diversity of St. Louis industry permits the student, through field trips, to gain a wide knowledge of processes to which industrial engineering principles can be applied. The industries of the area have co-operated with the department in applying industrial engineering to keep the student abreast of the latest developments. In some cases industrial equipment in the plants has been used directly in teaching courses. Part-time work in various plants, under the supervision of the plant personnel and the department faculty, is made available to selected senior students to provide an industrial laboratory for applying the information obtained in classes. One of the major purposes of the curriculum is to prepare the student to design proper and effective systems, procedures, and methods for industry *before* the work is to be performed.

SYNOPSIS OF CURRICULUM IN INDUSTRIAL ENGINEERING

First Year		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	GED 111	1	6		
Descriptive Geometry	GED 112			1	6
General Inorganic Chemistry	Chem 111	2	6		
Engineering Materials	Chem Eng 110			3	
Physics	Phys 220			2	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	14	9

Second Year		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Calculus	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Introductory Industrial Eng.	Ind Eng 212	2			
Metal Machining	Mech Eng 210		3		
Mechanisms	Mech Eng 214			2	3
Speech	Speech 211	3			
Machine Shop	Mech Eng 311				6
Accounting for Management	Acct 263	3			
Cost Accounting	Acct 363			3	
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	15	9	12	15

THIRD YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	LAB.	2nd Sem. REC.	LAB.
Engineering Statistics	Ind Eng 301	3			
Work Simplification	Ind Eng 305	2	3		
Statics and Dynamics	AM 201	4			
Thermodynamics	Mech Eng 323	3			
Welding and Heat Treatment	Mech Eng 305		3		
Economics	Econ 211	3			
Circuits and Machinery	Elec Eng 298-299	2		2	
Work Measurement	Ind Eng 306			2	3
Engineering Economy	Ind Eng 310			3	
Mechanization Methods	Ind Eng 370			1	3
Machine Design	Mech Eng 320			3	3
Elective[2]				6	
	Total	17	6	17	9

FOURTH YEAR

SUBJECT	COURSE	HOURS PER WEEK 1st Sem. REC.	LAB.	2nd Sem. REC.	LAB.
Introductory Math. Programming	Math 405	2			
Human Relations in Industry	Ind Eng 411	3			
Safety Engineering	Ind Eng 419	2			
Plant Layout & Mat. Handling	Ind Eng 424	1	6		
Preparation for Manufacture	Ind Eng 433	1	3		
Electronics	Elec Eng 348	3			
Electrical Laboratory	Elec Eng 336		3		
Elective[2]		3		3	
Engineering Law	Ind Eng 421			2	
Data Processing	Ind Eng 450			1	3
Production Control	Ind Eng 452			2	
Quality Control	Ind Eng 457			2	3
Field Trips	Ind Eng 382				3
Industrial Engrg. Problems	Ind Eng 494			3	
Fundamentals of Philosophy	Phil 305			3	
	Total	15	12	16	9

[2] Ind Eng 390 is strongly recommended for one of the three-hour elective courses.

MECHANICAL ENGINEERING

The field of mechanical engineering has undergone considerable technological development in the last decade, requiring an ever-broadening knowledge of the engineering technologist. The curriculum in mechanical engineering has been designed to provide the student with a broad base of scientific and technical knowledge, and to demonstrate the application of this knowledge to several specific areas, so that he may readily adapt himself to the particular needs of the industrial enterprise he is to serve.

The curriculum as outlined below, therefore, first provides adequate training in the basic sciences, physics and chemistry, the discipline of mathematics, and the skills of communication and expression. This is followed by a vigorous program in the specific areas of mechanics, of both solids and fluids, strength of materials, thermodynamics, heat transfer, electrical circuits, and electronics. The application of these principles is then developed simultaneously along several lines.

The training in design, required of all mechanical engineers, progresses systematically through a study of manufacturing processes, in a modern machine shop, welding shop, and heat-treatment laboratory. Classroom studies of properties and structures of metals are augmented by work in a well-equipped metallography laboratory. Courses in kinematics, machine design, and vibrations, and their associated drawing room problems supply the fundamentals for a mechanical design specialization. Laboratories for the study of heat transfer, fluid flow, fuels, vibrations, and instrumentation provide the opportunity for application of the principles presented in the lecture courses. Additional courses in electrical engineering, materials testing, economics, and engineering law are also required.

The senior year program provides for restricted elective courses, permitting study in areas of particular interest to the student. One group deals with internal combustion engines and other reciprocating machinery, centrifugal and turbo-machinery, and power plant and heat transfer equipment; the other deals with the analysis of mechanical engineering systems, instrumentation and control, advanced machine design, and ferrous or nonferrous metallurgy.

SYNOPSIS OF THE CURRICULUM IN MECHANICAL ENGINEERING

First Year

SUBJECT	COURSE	Hours per Week *1st Sem.* REC.	LAB.	*2nd Sem.* REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing	GED 111	1	6		
Descriptive Geometry	GED 112			1	6
General Inorganic Chemistry	Chem 111	2	6		
Industrial Chemical Calculations	Chem Eng 100			3	
Physics	Phys 220			2	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	14	9

Second Year

SUBJECT	COURSE	Hours per Week *1st Sem.* REC.	LAB.	*2nd Sem.* REC.	LAB.
Calculus	Math 215-216	4		4	
Physics	Phys 221-222	3	3	3	3
Statics	AM 203	3			
Mechanics of Materials	AM 250			3	
Mechanisms	Mech Eng 214*			2	3
Physical Metallurgy	Mech Eng 247*	2	3		
Metal Machining	Mech Eng 210				3
Welding and Heat Treatment	Mech Eng 305				3
Direct-Current Circuits	Elec Eng 213	3			
Electrical Circuits Lab. I	Elec Eng 303		3		
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	15	12	12	15

* One-half second-year class in each (214 and 247) first semester, alternate in second semester.

Third Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Machine Design	Mech Eng 321-322	2	3	2	3
Thermodynamics	Mech Eng 323-324	3		3	
Mechanical Laboratory	Mech Eng 334				3
Machine Shop	Mech Eng 311-312		6	1	3
AC Circuits	Elec Eng 321-324	3		3	
Kinetics	AM 303	3			
Materials Testing	Civ Eng 329	1	3		
Flow of Fluids	Mech Eng 370			3	
Group A Courses		3		3	
	Total	15	12	15	9

Group A Courses:

Economics	Econ 211-212
Economics	Econ 103-104
ROTC (third year)	
Engineering Economy	Ind Eng 310
Industrial Organization	Ind Eng 380
World Resources	Econ 315

Fourth Year

		Hours per Week			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
Heat Transfer	Mech Eng 371	3	3		
Electronics	Elec Eng 354-356	3	3		
DC and AC Machinery	Elec Eng 358			3	
English	Speech 211			3	
Engineering Law	Ind Eng 421			2	
Group B Courses		3	3	3	3
Group C Courses		3		3	
Seminar	Mech Eng 399				3
Elective		3		3	
	Total	15	9	17	6

Group B Courses

Reciprocating Engines	Mech Eng 391
Turbo-Machinery	Mech Eng 392
Heat Transfer Equipment	Mech Eng 395

Group C Courses

Advanced Machine Design	Mech Eng 421
Plant Engineering	Mech Eng 431
Anal. of Mech. Eng. Problems	Mech Eng 451
Instrumentation and Controls	Mech Eng 453
Ferrous Metallurgy	Mech Eng 447
Nonferrous Metallurgy	Mech Eng 448

METALLURGICAL ENGINEERING

The work of the metallurgical engineer is concerned primarily with the production, fabrication, and utilization of metals and alloys in manufacturing, chemical, electrical, aircraft, and many other industries. The curriculum in metallurgical engineering is designed to give the student a good basic preparation in the field of mechanical and physical metallurgy.

The curriculum in metallurgical engineering provides adequate training in the fundamentals of mathematics, chemistry, and physics. Professional courses in metallurgical engineering are begun during the sophomore year, which serve to introduce the student to the field of engineering.

Facilities in metallurgical engineering include metallurgical microscopes, gas-fired and electrical heat-treating furnaces, induction melting furnace for alloy preparation, controlled atmosphere heat-treating furnace, tensile tester, hardness testers, impact tester, metal polishing equipment, and X-ray diffraction apparatus.

Opportunities for inspection trips are varied because of the many industries in the St. Louis area performing metallurgical work.

FIRST YEAR

		HOURS PER WEEK			
		1st Sem.		*2nd Sem.*	
SUBJECT	COURSE	REC.	LAB.	REC.	LAB.
English	E Comp 101-102	3		3	
College Mathematics	Math 115-116	5		5	
Engineering Drawing and Descriptive Geometry	GED 111-112	1	6	1	6
General Inorganic Chemistry	Chem 111	2	6		
Qualitative Analysis	Chem 112			2	6
Physics	Phys 220			2	
Physical Education 101-102, Air or Military Science 101-102, or Band			3		3
	Total	11	15	13	15

Second Year

SUBJECT	COURSE	Hours per Week 1st Sem. REC.	LAB.	2nd Sem. REC.	LAB.
English	Speech 211	3			
Calculus	Math 215-216	4		4	
Quantitative Analysis	Chem 241	2	6		
Physics	Phys 221-222	3	3	3	3
Statics and Dynamics	AM 201			4	
Metal Machining	Mech Eng 210				3
Engineering Materials	Met E 201	2			
Elective				3	
Physical Education 201-202, Air or Military Science 201-202, or Band			3		3
	Total	14	12	14	9

Third Year

SUBJECT	COURSE	Hours per Week 1st Sem. REC.	LAB.	2nd Sem. REC.	LAB.
Physical Chemistry	Chem 471-472	3	3	3	3
Circuits and Machinery	Elec Eng 298-299	2		2	
Mechanics of Materials	AM 250	3			
Engineering Materials	Civ Eng 329	1	3		
Economics	Econ 211	3			
Engineering Economy	Ind Eng 310			3	
Welding and Heat Treatment	Mech Eng 305		3		
Mechanisms	Mech Eng 214			2	3
Physical Metallurgy	Met E 301-302	3		3	
Metallurgical Laboratory	Met E 303-304		3		3
Thermodynamics	Mech Eng 323			3	
	Total	15	12	16	9

Fourth Year

SUBJECT	COURSE	Hours per Week 1st Sem. REC.	LAB.	2nd Sem. REC.	LAB.
Engineering Law	Ind Eng 421			2	
Industrial Organization	Ind Eng 380	3			
Machine Design	Mech Eng 321	2	3		
Electronics	Elec Eng 348			3	
Electrical Laboratory	Elec Eng 336				3
Metallurgy of Iron & Steel	Met E 411	3			
Metallurgy Laboratory	Met E 423		3		
Nonferrous Metallurgy	Met E 410			3	
Electives		6		6	
	Total	14	6	14	3

SUGGESTED ELECTIVES

Many advanced courses in the following departments of the College of Liberal Arts are automatically open as electives to Engineering students on the basis of fulfilled prerequisites:

Economics: To students who have completed Economics 211-212.

Mathematics: To juniors and seniors who have had the usual required mathematics.

Physics: To students who have had Physics 220-221-222 and the usual required mathematics.

In addition, the courses listed below are open as electives to Engineering students who fulfill the minimum year-level requirements:

Fall Semester 1959-60

1. Open to freshmen and all students above the freshman level:
   - Art and Archaeology 100: Introduction to Art
   - Botany 101: General Biology
   - Geography 101: Physical Geography
   - Geology 101: General Geology
   - History 101: Western Civilization, 11th through 18th Century
   - Music 101: Introduction to Music
   - Philosophy 101: Elementary Logic
   - Philosophy 105: Introduction to the Problems of Philosophy
   - Philosophy 107: Introduction to Ethics
   - Political Science 101: American Government and Politics
   - Sociology-Anthropology 101: Peoples and Cultures of the World
2. Open to sophomores and all students above the sophomore level:
   - Art and Archaeology 201: Modern Art
   - Classics 205: The Greek Classics and the Old Testament
   - Dramatics 211: Play Production
   - Education 203: An Introduction to Education
   - English Composition 311: Exposition and Argument
   - English Composition 321: Advanced Writing: Fiction
   - English Literature 211: Chief English Writers
   - Geology 231: Mineralogy and Petrology
   - History 203: Development of the United States
   - History 211: English History to 1603
   - Philosophy 221: Major Religions of the East
   - Political Science 213: Modern Government
   - Psychology 205: General Psychology
   - Sociology-Anthropology 203: Introduction to Cultural Anthropology
   - Sociology-Anthropology 205: Introduction to Sociology
   - Speech 221: Oral Interpretation of Literature
   - Zoology 203: Human Biology
3. Open to juniors and seniors:
   - Art and Archaeology 301: Greek and Roman Art
   - Classics 317: The Greek World
   - General Literature 331: Tragedy
   - History: Any course on the student's class level or lower

Philosophy 301: Principles of Logic
Philosophy 313: Greek Philosophers: Plato
Political Science 301: American State Government
Political Science 311: Politics: Parties and Interest Groups
Sociology-Anthropology 323: The Urban Community

Spring Semester 1959-60

1. Open to freshmen and all students above the freshman level:
   Art and Archaeology 100: Introduction to Art
   Geography 102: Social Geography
   Geology 101: General Geology
   History 102: Western Civilization, 19th and 20th Centuries
   Music 102: Introduction to Music
   Music 122: Theory of Music
   Philosophy 101: Elementary Logic
   Philosophy 105: Introduction to the Problems of Philosophy
   Philosophy 107: Introduction to Ethics
   Political Science 102: Comparative Politics
   Sociology-Anthropology 102: Peoples and Cultures of the World
2. Open to sophomores and all students above the sophomore level:
   Classics 206: Greek Philosophy and the New Testament
   Education 203: An Introduction to Education
   English Composition 211: Practice in Composition
   English Composition 311: Exposition and Argument
   English Composition 322: Advanced Writing: Poetry
   English Literature 211: Chief English Writers
   History 204: Development of the United States
   History 212: English History since 1603
   Philosophy 222: Major Religions of the West
   Psychology 205: General Psychology
   Sociology-Anthropology 203: Introduction to Cultural Anthropology
   Sociology-Anthropology 205: Introduction to Sociology
   Speech 221: Oral Interpretation of Literature
3. Open to juniors and seniors:
   Art and Archaeology 302: Greek and Roman Art
   Classics 318: The Roman World
   General Literature 301: Greek Mythology and Poetry
   General Literature 332: Comedy
   History: Any course on the student's class level or lower
   Philosophy 314: Greek Philosophers: Aristotle
   Political Science 302: American City Government
   Sociology-Anthropology 313: Marriage and the Family
   Sociology-Anthropology 321: Interracial and Intercultural Relations
   Sociology-Anthropology 322: Peasant Cultures

COURSES OF INSTRUCTION

Courses numbered 100 to 199 are for first-year students.

Courses numbered 200 to 299 are for second-year students.

Courses numbered 300 to 399 are for third-year and fourth-year students.

Courses numbered 400 to 499 are for third-year and fourth-year students, and possibly for Graduate Students.

APPLIED MECHANICS

Professors Mesmer, Ornstein; Visiting Professor Hohenemser; Instructor Gerber

121. ENGINEERING MECHANICS I, INTRODUCTION. Three class hours a week. Either semester. Credit 3 units.

Units. Forces and moments. Vectors. Equilibrium of particles, strings, bars, and two-dimensional bodies. Uniformly distributed forces. Centroid of simple areas and bodies. Elastic deformation of springs. Work and elastic energy. Linear translation, velocity, acceleration. Newton's Law, mass and weight, kinetic equilibrium. Work and kinetic energy. Rotation, angular velocity and acceleration. Moment of inertia.

122. ENGINEERING MECHANICS II, STATICS. Prerequisite, Applied Mechanics 121. Three class hours a week. Second semester. Credit 3 units.

Method of sections. Trusses, beams, frames, cables. Normal force, shear and moment diagrams. Distributed forces. Hydrostatics. Friction. Uniform stress. Mohr's Circle of stress. Hooke's Law. Stress and strain in bars and trusses, shear-stress and strain in shear panels.

201. STATICS AND DYNAMICS. Prerequisite, Mathematics 215. Four class hours a week. Either semester. Credit 4 units.

An introduction to the applications of the laws of equilibrium and motion to engineering problems. Equilibrium of beams, trusses, frames. Laws of dry friction. Kinematics of particles, rigid bodies, Newton's laws, D'Alembert's principle. Energy. Momentum.

203. STATICS. Prerequisite, Mathematics 116. Three class hours a week. Either semester. Credit 3 units.

Application of the laws of equilibrium to engineering problems. Forces on beams, trusses, frames. String polygons. Shear- and moment-diagrams of beams. Laws of dry friction.

250. MECHANICS OF MATERIALS. Prerequisite, Mathematics 215 and Applied Mechanics 201 or 203. Three class hours a week. Either semester. Credit 3 units.

Determination of stresses and strains in simple machine and structural elements. Normal and shear stresses. Mohr's circle. Hooke's law. Torsion and bending. Deflection of beams. Indeterminate systems. Strain energy. Columns. Euler's load.

299. Introduction to Dynamics. Prerequisite, Mathematics 216, Applied Mechanics 203. Two class hours a week. First semester. Credit 2 units.

Kinematics of a particle. Constant acceleration. Motion along a circle. Translation and rotation of simple rigid bodies. Newton's law. D'Alembert's principle. Energy. Momentum.

303. Kinetics. Prerequisite, Mathematics 216 and Applied Mechanics 203. Three class hours a week. Either semester. Credit 3 units.

Kinematics of plane motions. Newton's laws. Rectilinear, curvilinear, and rotational acceleration of particles and rigid bodies. Harmonic vibrations with one degree of freedom. D'Alembert's principle. Energy. Momentum. Moment of momentum. Gyroscopic moment.

399. Engineering Mechanics. Three class hours a week. Either semester. Credit 3 units.

Basic topics of Statics, Strength of Materials, and Kinetics. This course is not a substitute for 203, 250 or 303 for engineers, but is offered as a refresher course for graduate students or for students majoring in other schools.

402. Special Problems in Fundamental Mechanics. Hours and credit to be arranged. Either semester.

Discussion of problems, additional to the general undergraduate courses. Offered for undergraduate students with special abilities and interests.

407. Mechanical Vibrations. Three class hours a week. Second semester. Credit 3 units.

Free and forced vibrations of systems with one degree of freedom, linearization. Systems with several degrees of freedom, normal modes. Vibrations of continuous systems (strings, beams, shafts). Numerical and approximate solutions. Methods of Rayleigh, Holzer, and Stodola.

416. Stress and Strain in Elastic Bodies. Three class hours a week. Second semester. Credit 3 units.

Problems in plane stress and strain. Airy's function. Torsion of cylinders. Analogies. Stress and strain tensors. Strain energy. Theories of failure. Stability problems.

419. Airplane Stress Analysis. Three class hours a week. First semester. Credit 3 units.

Analysis of rings and frames. Axial and shear stresses in wings and fuselages, including effects of shear deformation, sheet buckling, and discontinuities. Compression members: local crippling, plastic behavior, torsional failure, lateral loading. Diagonal tension fields.

426. Experimental Stress Analysis. Two class hours and one laboratory period a week. Either semester. Credit 3 units.

Basic methods of experimental determination of stresses in structures and machines. Mechanical, optical, and electrical gages. Use of brittle lacquer. Photoelastic methods and auxiliary techniques for plane and three-dimensional problems.

427. Fluid Mechanics. Three class hours a week. First semester. Credit 3 units.

Methods of classical hydrodynamics which are basic to aerodynamic theory. The equations of Euler and Bernoulli. Potential flow in two and three dimensions. Vortices. The Navier-Stokes equations and viscosity effects. Boundary layer theory.

433. Introduction to Plates and Shells. Three class hours a week. Second semester. Credit 3 units.

Basic linear theory of thin circular plates, symmetrically loaded. Rectangular plates. Membrane theory of axially symmetrical and cylindrical shells. Bending theory of circular cylindrical shells. (Beams on elastic foundation.) Stability problems.

ARCHITECTURE[1]

Professors Passonneau, Bockhorst, Pickens; Associate Professors Anselevicius, Laskey, Oswald, Wright; Assistant Professors Maki, Montgomery; Critics Entzeroth, Mutrux, Smith; Instructors Hunter, Kasal, Layton

101-102. Introduction to Architecture. Credit 4 units for the year.

A course of lectures, discussions, and laboratory periods, describing the important role of the architect in contemporary society, and beginning the student's visual training.

301-302. Drawing and Color. Both semesters. Credit 2 units each semester.

Sketching and architectural drawing. Taught as part of Elementary Design 311-312.

311-312. Elementary Design. Both semesters. Credit 5 units each semester.

Awareness, experimentation, development, realization of visual elements. Two and three dimensions, structure, color, history, materials, form.

327. History of Architecture. First semester. Credit 3 units.

The architecture of the Ancient World, from the earliest times to Constantine, with reference to its historical and cultural context.

328. History of Architecture. Second semester. Credit 3 units.

The architecture of medieval Europe and the Byzantine Empire, from Constantine to 1500, with reference to its historical and cultural context.

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[1] For information about the Architectural Curriculum, write to the Office of the Dean, School of Architecture.

331. Architectural Graphics. Three class hours a week. First semester. Credit 3 units.

Descriptive geometry. The theory of projection as it relates to the solution of three-dimensional problems.

332. Architectural Graphics. Three class hours a week. Second semester. Credit 3 units.

A study of shades and shadows and the construction of architectural perspectives.

427. History of Architecture. First semester. Credit 3 units.

European architecture in the Age of Humanism, the Renaissance, to 1800, with reference to its historical and cultural context.

428. History of Architecture. Second semester. Credit 3 units.

American architecture of the seventeenth and eighteen centuries and the development of the new architecture from 1800 to the present.

433. Materials of Construction and Working Drawings. First semester. Credit 3 units.

The study of materials in buildings of frame and semi-fireproof construction and the preparation of contract drawings.

434. Materials of Construction and Working Drawings. Prerequisite, Architecture 433. Second semester. Credit 3 units.

The study of materials in buildings of fireproof construction and the preparation of scale details.

443. Architectural Acoustics. Prerequisite, Physics 106. First semester. Credit 1 unit.

A study of the theory of sound as it affects the design of buildings for control of acoustical properties.

444. Sanitation. Prerequisite, Architecture 434. Second semester. Credit 1 unit.

The study of water supply and sewerage systems of buildings in the interest of convenience, economy, and health.

613-614. City Planning. Both semesters. Credit 3 units each semester.

Theory and design, with special reference to problems of Metropolitan St. Louis.

645. Specifications and Office Practice. Prerequisite, Architecture 434. First semester. Credit 2 units.

Preparation of specifications and study of office administration and professional practice.

646. Estimating and Contracting. Prerequisite, Architecture 434. Second semester. Credit 2 units.

A study of the professional relationship between owner, architect, and contractor. Preparation of quantity survey and materials list.

ARMY AND AIR SCIENCE

Army: Colonel Cheal; Lieutenant Colonels Lundberg, Whited; Major Covey; Captain Williams; Lieutenant Iverson

Air Force: Lieutenant Colonel DeLano; Major Reed; Captains Bryan, Cain, Mueller

Air Science

AS 101-102. FOUNDATIONS OF AIR POWER I. Two class hours and two hours of leadership laboratory a week. Credit 2 units for the year.

For freshmen. A general survey of air power designed to provide the student with an understanding of the elements of air power and basic aeronautical science. Basic military training.

AS 201-202. FOUNDATIONS OF AIR POWER II. Prerequisite, AS 101-102 or the equivalent. Two class hours and two hours of leadership laboratory a week. Credit 2 units for the year.

For sophomores. A year-long survey of the development of aerial warfare with emphasis on principles of war, concept of employment of forces, and changing weapons systems. Treatment of aerial warfare covers targets, weapons systems, delivery vehicles, bases and operations. Basic military training continued, with emphasis on leadership in supervisory Cadet Corps positions.

AS 301-302. AIR FORCE OFFICER DEVELOPMENT. Prerequisite, AS 201-202 or the equivalent, and selection. Four class hours and two hours of leadership laboratory a week. Credit 6 units for the year.

For juniors. A year-long treatment of the knowledge and skills required of a junior officer in the Air Force, with special emphasis on staff duties and leadership. Includes Air Force leadership doctrine, staff organization and functions, communicating, instructing, problem-solving techniques, leadership principles and practices, and military justice system; junior officer training through experience in planning and supervising Cadet Corps activities. Includes four weeks attendance on an Air Force base between AS 302 and AS 401.

AS 401-402. LEADERSHIP AND AIR POWER CONCEPTS. Prerequisite, AS 301-302. Four class hours and two hours of leadership laboratory a week. Credit 6 units for the year.

For seniors. Leadership and management; military aspects of world political geography; foundations of national power; military aviation and the evolution of warfare; career guidance; briefing for commissioned service. Officer leadership training through actual experience in planning and directing activities of the Cadet Corps. When feasible, 36½ hours of flight instruction in light aircraft is offered to senior cadets who are enrolled for pilot training.

Military Science

MS 101-102. BASIC COURSE. Three class hours and one hour leadership laboratory a week. Credit 2 units for the year.

Primarily for freshmen. Introduction to military science; American military history; leadership, drill, and command; individual weapons and marksmanship.

MS 201-202. Basic Course. Prerequisite, MS 101 and 102, or equivalent military instruction. Three class hours and one hour leadership laboratory a week. Credit 2 units for the year.

Primarily for sophomores. Map and aerial photograph reading; crew-served weapons and gunnery; role of the Army; leadership, drill, and command.

MS 301-302. Advanced Course. Prerequisite, MS 201-202 or equivalent military training. Five class hours and one hour leadership laboratory a week. Credit 6 units for the year.

Primarily for juniors. Leadership; military teaching principles; small unit tactics and communication; branches of the Army; pre-camp orientation; leadership, drill, and command.

MS 401-402. Advanced Course. Prerequisite, MS 301-302. Five class hours an one hour leadership laboratory a week. Credit 6 units for the year.

Primarily for seniors. Military administration, logistics, military justice, operations; service orientation; leadership, drill, and command.

Leadership Laboratory. All classes in Military Science, as indicated above, meet each Monday from 4:00 to 5:00 p. m., at Intramural Field or in designated auditoriums.

BUSINESS

Accounting. For elementary course, see Economics 261-262.

Accounting 263. Accounting for Management. Three class hours a week. Credit 3 units.

The nature of business activities, using an accounting approach to the analysis of business operations. The elements of an accounting system, de-emphasizing specialized record-keeping techniques and procedures. A bird's-eye view of accounting valuation and earnings-determination theory.

Accounting 363. Cost Accounting. Prerequisite, Economics 262 or Accounting 263. Three class hours a week. Credit 3 units.

The application of cost principles and procedures to job order and process production; classification of accounts; materials control and inventory methods; accounting for labor; allocation of burden costs; cost statements.

Finance 340. Financial Institutions. Prerequisite, Economics 204 or 212. Three class hours a week. Credit 3 units.

A survey of financial institutions including commercial banks, trust companies, commercial credit companies, insurance companies, investment banks, urban and farm real estate credit agencies, and consumer credit organizations. A study of the development and operation of the commercial banking system, including the Federal Reserve System and its relationship to the other financial institutions. The role of money and credit in economic affairs and an analysis of the effect of monetary and credit policies on the economy and their relationship to sound business management.

Finance 341. BUSINESS FINANCE. Prerequisite, Finance 340 and Economics 262. Three class hours a week. Credit 3 units.

A study of the basic principles governing the financial operations of business, with emphasis on the problems and policies of small and medium-sized businesses. Financial considerations in promotion and the selection and development of the form of organization, tools of financial analysis, principles and instruments of long-term and short-term financing, income management, and financial aspects of busiess failure.

Marketing 326. PRINCIPLES OF MARKETING. Prerequisite, Economics 203 and 204. Three class hours a week. Credit 3 units.

Marketing functions; transportation; storage; trade channels; development of marketing methods; organized produce exchanges; wholesale dealers and jobbers; the work of department stores, mail order houses, chain and independent stores.

Personnel 323. PERSONNEL ADMINISTRATION. Three class hours a week. Credit 3 units.

Sources of labor supply, job analysis, methods of interviewing and selecting workers, problems of promotion and transfer, training, wage policies, and collective bargaining.

CHEMICAL ENGINEERING

Professors Stout, Armstrong; Associate Professors Holsen, McKelvey; Assistant Professors Esterson, Marsh; Lecturers L. Stout, Jr., Kaufman; Intructor Storr

100. INDUSTRIAL CHEMICAL CALCULATIONS. Prerequisite, Chemistry 111. Three class hours a week. Either semester. Credit 3 units.

The application of certain fundamental principles of chemistry to problems in gas expansion and compression, vapor pressures, combustion processes, phase rule studies, and additional subjects of importance to engineers other than those in the Chemical and Geological curricula.

110. ENGINEERING MATERIALS. Prerequisite, Chemistry 111. Three class hours a week. Either semester. Credit 3 units.

The purpose of this course is to relate the chemical and physical properties of engineering materials to their suitability for various uses. The topics covered include ferrous and non-ferrous metals and alloys, concrete, ceramics, wood, protective coatings, resins, plastics, elastomers, etc., and the theory of corrosion.

120. CHEMISTRY FOR CIVIL ENGINEERS. Prerequisite, Chemistry 111. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

The application of basic principles of biochemistry, organic chemistry, physical chemistry, and analytical chemistry to problems in Civil Engineering.

213. INORGANIC TECHNOLOGY. Prerequisite, Chemistry 112. Three class hours a week, or substitution of plant visits. First semester. Credit 3 units.

Lectures and plant visits dealing with industrial operations in the inorganic chemical and electrochemical field, emphasizing raw material relations, economics, process developments, materials of construction, and essential engineering features.

214. Chemical Engineering Stoichiometry. Prerequisite, Chemistry 112 and Mathematics 116. Three class hours a week. Second semester. Credit 3 units.

The application of fundamental physical laws to the calculation of material balances and heat balances.

341. Unit Operations I. Prerequisite or concurrent, Chemistry 421, Mathematics 216, Chemical Engineering 214. Three class hours a week. First semester. Credit 3 units.

A discussion of the fundamental principles of the unit operations of flow of fluids, transportation of fluids, flow of heat, and evaporation, with special emphasis on the solution of selected problems.

342. Unit Operations II. Prerequisite, Chemical Engineering 341. Second semester. Three class hours a week. Credit 3 units.

A discussion of the fundamental principles of the unit operations of humidification, drying, distillation, and filtration, with special emphasis on the solution of selected problems.

344. Chemical Engineering Laboratory I. Prerequisite, Chemical Engineering 341. One double laboratory period a week. Credit 2 units.

Selected laboratory experiments on flow of fluids, flow of heat, evaporation, and drying.

352. Chemical Engineering Thermodynamics. Prerequisite, Mathematics 216, Chemistry 421. Three class hours a week. Either semester. Credit 3 units.

Fundamentals of thermodynamics and application of thermodynamics to selected problems arising in the chemical industry.

432. Organic Technology. Prerequisite, Chemistry 254. Chemical Engineering 213. Three class hours a week, or substitution of plant visits. Second semester. Credit 3 units.

Lectures and plant visits dealing with industrial operations in the organic process industries, emphasizing raw material relations, economics, process developments, materials of construction, and essential engineering features.

435. Instrumentation and Control. Prerequisite, Chemical Engineering 341, 344. Two class hours and one laboratory period a week. First semester. Credit 3 units.

Discussion of the basic operating principles of control instruments and their application to industrial chemical processes. The laboratory investigations will cover both the use of various instruments for measuring, recording, and controlling, and studies of the behavior of complete control systems.

441. Unit Operations III. Prerequisite, Chemical Engineering 341. Three class hours a week. First semester. Credit 3 units.

A discussion of the fundamental principles of the unit operations of absorption, extraction, and crystallization with special emphasis on the solution of selected problems.

443. Chemical Engineering Laboratory II. Prerequisite, Chemical Engineering 344, 441 (or concurrent). One double laboratory period a week. Credit 2 units.

Selected laboratory experiments on distillation, absorption, extraction, crystallization, filtration, and crushing and grinding.

444. Chemical Engineering Laboratory III. Prerequisite, Chemical Engineering 443. One double laboratory period a week. Credit 2 units.

Selected laboratory experiments in inorganic and organic processes.

461. Mathematics for Chemical Engineers. Prerequisite, Mathematics 311. Three class hours a week. Second semester. Credit 3 units.

A course dealing with numerical analysis and the application of differential equations to selected problems in Chemical Engineering.

462. Chemical Engineering Design. Prerequisite, Chemical Engineering 352, 435, 441. Three class hours and one laboratory period a week. Second semester. Credit 4 units.

Applications of fundamental knowledge and skill in the field of chemistry, mathematics, engineering drawing, unit operations and processes, and thermodynamics to the design and layout of equipment and plant to make a selected chemical product. Liberal use is made of guest lecturers who are specialists in the field of chemical engineering.

490. Special Problems in Chemical Engineering. Prerequisite, Chemical Engineering 213, 342, 344. Three laboratory periods a week. Credit 3 units.

Individual laboratory or library investigations of selected problems in Chemical Engineering. Recommended only for superior students upon approval by the department.

CHEMISTRY

Professors Sowden, Helmholz, Lipkin, Potratz, Wahl, Weissman; Associate Professors Goldstein, Gutsche, Rodewald; Assistant Professors Holtzer, Pilger

111. General Inorganic Chemistry. Two class hours and two laboratory periods a week. First semester. Credit 4 units.

Systematic treatment of fundamental chemical principles and their applications, with particular reference to atomic and molecular theories, laws of chemical combination, periodic classification of the elements, and properties of gases, liquids, solids, and solutions.

112. General Inorganic Chemistry and Qualitative Analysis. Prerequisite, Chemistry 111. Two class hours and two laboratory periods a week. Second semester. Credit 4 units.

Lectures on chemistry of metals with laboratory work in qualitative analysis. Particular attention is given to the study of electrolytes and ionic equilibria.

241. Quantitative Analysis: Volumetric and Gravimetric Analysis. Prerequisite, Chemistry 112. Two class hours and two laboratory periods a week. First semester. Credit 4 units.

Theory and practice of quantitative volumetric and gravimetric analysis.

254. Organic Chemistry. Prerequisite, Chemistry 111. Three class hours and two laboratory periods a week. Second semester. Credit 5 units.

Short course in organic chemistry dealing with compounds of the aliphatic and aromatic series.

301-302. Organic Chemistry.[1] Prerequisite, Chemistry 241 and junior standing. Three class hours a week. Both semesters. Credit 6 units.

A course covering the compounds of the aliphatic and aromatic series. Consideration of the behavior of organic compounds on the basis of their electronic structures.

305-306. Laboratory Work in Organic Chemistry. Prerequisite or concurrent, Chemistry 301-302. Two laboratory periods a week. Both semesters. Credit 4 units.

421-422. Physical Chemistry.[2] Prerequisite, junior standing, Chemistry 241, 6 units of Physics, and Integral Calculus. Three class hours a week. Both semesters. Credit 6 units.

Laws and theories concerning the properties of solids, liquids, and gases. Introduction to chemical thermodynamics, homogeneous and heterogeneous equilibrium, thermochemistry, electrochemistry, atomic and molecular structure, rates of chemical processes.

423-424. Physical Chemistry Laboratory. Prerequisite, Chemistry 241 and concurrent enrollment in Chemistry 421-422. One laboratory period a week. Both semesters. Credit 2 units.

471-472. Physical Chemistry. Prerequisite, Chemistry 242, 6 units of Physics, and Integral Calculus. Three class hours and one laboratory period a week. Credit 8 units for the year.

Laws and theories concerning the properties of solids, liquids, and gases. Introduction to chemical thermodynamics, homogeneous and heterogeneous equilibrium, thermochemistry, electrochemistry, atomic and molecular structure, rates of chemical processes.

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[1] Liberal Arts Chemistry 351.
[2] Liberal Arts Chemistry 471.

CIVIL ENGINEERING

Professors Burbank, Brielmaier, Brust, Reitz; Associate Professors Andrews, Hundley, Ryckman; Assistant Professors Edgerley, Schenler; Lecturers Brucker, Lapin, Taylor, Wenthe, Wood; Instructors Gillespie, Greenberg

211. Elementary Surveying. Prerequisite, Mathematics 115. One class hour and two laboratory periods a week. Second semester. Credit 3 units.

Familiarization with surveying instruments and procedures. Field problems in vertical and horizontal control.

213. Elementary Surveying. For Geological Engineers. Elective for Architects. Prerequisite, Mathematics 115. One class hour and one laboratory period a week. Either semester. Credit 2 units.

Similar to Civil Engineering 211 except that emphasis is placed on calculation of earthwork quantities and on site plans.

216. Engineering Surveys. Prerequisite, Civil Engineering 211. Two class hours and two laboratory periods a week. Either semester. Credit 4 units.

Principles of topographic and construction surveys.

220. Elements of Photogrammetry. Prerequisite, General Engineering Drawing 112 and Civil Engineering 211. One laboratory period a week. Either semester. Credit 1 unit.

Basic mathematics of vertical and oblique photographs. Stereoscopic plotting instruments. Civil Engineering applications.

329. Engineering Materials. For Mechanical Engineers. Prerequisite, Applied Mechanics 250. One class hour and one laboratory period a week. First semester. Credit 2 units.

Class and laboratory study of the properties of common structural materials, the physical and chemical background of these properties and how they may be controlled or influenced by production and fabrication methods.

336. Highways and Airports. Prerequisite, Civil Engineering 216, 337 (or concurrently with Civil Engineering 337). Three class hours a week. Second semester. Credit 3 units.

Organization and operation of federal, state, county, and city highway organizations. Drainage problems; traffic requirements, grading operations; properties of bituminous materials; types of surfaces; planning and construction of airports.

337. Engineering Materials. For Architectural and Civil Engineers. Prerequisite, Applied Mechanics 250. Two class hours and one laboratory period a week. Either semester. Credit 3 units.

Class and laboratory study of the properties of common structural materials, the physical and chemical background of these properties and how they may be controlled or influenced by production and fabrication methods.

338. Hydraulics. For Architectural, Civil, and Geological Engineers. Prerequisite, junior standing. Three class hours a week. Either semester. Credit 3 units.

Properties of fluids; hydrostatics; hydrodynamics; introduction to open channel flow.

340. Concrete Mixes. Prerequisite, Applied Mechanics 250 (or concurrent). One class hour and one laboratory period a week. Second semester. Credit 2 units.

Specifications, production, sampling and testing of the materials used in mortars, Portland cement concrete, and bituminous concrete. Proportioning and mix design.

341. Stresses in Framed Structures. For Architectural and Civil Engineers. Prerequisite, Applied Mechanics 250. Three class hours a week. First semester. Credit 3 units.

Live and impact loads; stresses in beams and trusses; influence lines; lateral and wind loads; portal and wind bracing; and other typical problems of statically determinate structures.

348. Hydraulic Laboratory. For Civil and Geological Engineers. Prerequisite (or concurrently with) Civil Engineering 338. One laboratory period a week. Either semester. Credit 1 unit.

Calibration of metering devices; flow in pipes; flow in open channels.

354. Structural Steel Design. For Architectural and Civil Engineers. Prerequisite, Civil Engineering 341. Three class hours a week. Second semester. Credit 3 units.

Elements of frame design and connection of members.

355. Structural Design. Prerequisite, Civil Engineering 354. One class hour and two laboratory periods a week. First semester. Credit 3 units.

Design of steel framed structures; study of building codes.

356. Reinforced Concrete Design. Prerequisite, Civil Engineering 341. Three class hours a week. Second semester. Credit 3 units.

Basic theories of beams, slabs, and columns; combined axial stresses and bending; footings; and retaining walls.

358. Engineering Design. Prerequisite, Civil Engineering 356. One class hour and two laboratory periods a week. Second semester. Credit 3 units.

Design and details of the various types of reinforced concrete structures; fundamentals of the theory of prestressed concrete.

360. Elements of Structural Engineering. Prerequisite, Applied Mechanics 250. Three class hours a week. Elective for students not taking the regular structural courses. Either semester. Credit 3 units.

Design of elementary wood, steel, and concrete structures.

382. Sanitary Engineering Science. Prerequisite, Civil Engineering 338, 348, Chemical Engineering 120. Three class hours a week. First semester. Credit 3 units.

The study of basic principles of chemistry, physics, and fluid mechanics involved in the design, construction, and operation of water supply and waste water systems.

385. Construction Planning and Organization. Elective. Prerequisite, senior standing. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

Based on the experiences of large contracting firms.

386. Contracts and Specifications. Required for Construction Option. Elective for students in General Option. Prerequisite, senior standing. Three class hours a week. Second semester. Credit 3 units.

The essential legal features of contracts and specifications as applied to construction industry.

393. Professional Practice. Prerequisite, senior standing. One class hour a week. First semester. Credit 1 unit.

Lectures and discussions on the broad aspects of the practice of Civil Engineering.

394. Special Problems. Prerequisite, senior standing. One conference hour and two laboratory periods a week. Either semester. Credit 3 units.

A problem in Civil Engineering approved by the department chairman.

395. Construction Cost Controls. Required for Construction Option. Elective for General Option. Prerequisite, senior standing. Three class hours a week. First semester. Credit 3 units.

Planned versus hunch decisions. Relative economy of alternatives. Calculation of annual cost, present value, and prospective rates of return. The economic effects of interest and taxation; depreciation and obsolescence of physical property; intangible values. Cost accounting.

405. Indeterminate Structures I. Prerequisite, Civil Engineering 341. Three class hours a week. First semester. Credit 3 units.

Analysis of continuous beams and simple frames by moment area, slope deflection, and moment distribution methods.

406. Indeterminate Structures II. Prerequisite, Civil Engineering 405. Two class hours and one laboratory period a week. Elective. Second semester. Credit 3 units.

Unsymmetrical, multi-span and multi-story frames; arches; truss deflections, indeterminate trusses.

407. Ultimate Design. Prerequisite, Civil Engineering 405. One class hour a week. Second semester. Credit 1 unit.

Fundamental and elementary concepts of plastic or limit design in structures.

419. Soil Mechanics. Prerequisite, Mechanics 250, Civil Engineering 338, and Geology 367. Two class hours and one laboratory period a week. First semester. Credit 3 units.

A general study of the properties of soils as related to engineering problems.

420. Mechanics of Soils. Elective. Prerequisite, Civil Engineering 419. Three class hours a week. Second semester. Credit 3 units.

Strengths of soils, stability of slopes, settlement, active and passive pressures.

422. Seepage. Elective. Prerequisite, Civil Engineering 419. Three class hours a week. Credit 3 units.

A study of the movement of incompressible fluids through permeable media. Use of analytical, graphical, model, and electrical methods of investigation. Applications to engineering practice.

451. Hydrology. Prerequisite, Civil Engineering 338 and 348. Three class hours a week. First semester. Credit 3 units.

Basic meteorology; statistical methods; yield and flood runoff; hydraulic applications.

453. Flow in Open Channels. Elective. Prerequisite, Civil Engineering 338. Three class hours a week. First semester. Credit 3 units.

Hydraulic jump, backwater curves, slowly varied flow.

464. Foundations. Prerequisite, Civil Engineering 356, 419. Three class hours a week. Second semester. Credit 3 units.

Principal problems in design and construction of foundations for bridges and buildings; modern developments in piling, cofferdams, open caissons, pneumatic caissons.

471-472. Construction Methods, Estimates, and Costs. Required for Construction Option. Elective for students in General Option. Prerequisite, senior standing. Two class hours and one laboratory period a week. Both semesters. Credit 6 units.

A general study of methods of engineering construction as practiced by engineers and contractors; problems in estimating; visits to construction projects; special lectures by contractors.

485. Sanitary Engineering Design. Prerequisite, Civil Engineering 382. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

Design of water supply and waste water disposal systems for both municipal and industrial operations. Laboratory work includes computations and investigations necessary to obtain a basis for design and operation of sanitary engineering facilities.

ECONOMICS

Professors Hochwald, Buchan;[1] Associate Professors Hirsch, Kagan, Murphy, Sobel; Assistant Professors Martin, Ridker, Schloss, Weisbrod; Instructor Meyerding

103-104. INTRODUCTION TO POLITICAL ECONOMY. Three class hours a week. Credit 6 units for the year.

An introductory analysis of economic ideas and the operation of the American economy. *First semester:* Evolution of modern economic thought; organization and institutions of the American economy; business fluctuations; monetary and fiscal policy. *Second semester:* Determination of prices; distribution of national income; international economic relations. A student may not have credit for both Econ 103-104 and 211-212.

210. GROWTH OF THE AMERICAN ECONOMY. Prerequisite, sophomore standing. Three class hours a week. Each semester. Credit 3 units.

Historical introduction to the basic institutions of the American economy; America's growth to leadership in the world economy.

211-212. PRINCIPLES OF ECONOMICS. Prerequisite, Mathematics 104 or 115. Three class hours a week. Both semesters. Credit 6 units.

Introductory analysis of the American economy, primarily for students of engineering and the sciences. *First semester:* Growth of the American economy; productive organization and activity in an enterprise economy; consumption, saving, and investment; the role of money. *Second semester:* Inflation and deflation; prices, production, and resources; wages and profits; America and the world economy. A student may not have credit for both Economics 203-204 and 211-212.

214. COMPARATIVE ECONOMC ORGANIZATION. Prerequisite, sophomore standing. Three class hours a week. Credit 3 units.

A comparative study of economic organization and operations in different national economies. Emphasis on comparisons between the economies of the United States, Western Europe, Soviet Russia, and selected underdeveloped countries.

231. INTRODUCTION TO STATISTICS. Prerequisite, sophomore standing. Three class hours a week. Each semester. Credit 3 units.

Introduction to the fundamental concepts of statistics; frequency distributions; decision making on the basis of incomplete information; the laws of chance in their relation to statistical inference.

261. PRINCIPLES OF ACCOUNTING I. Prerequisite, sophomore standing. Three class hours a week. Credit 3 units.

Development of a logical framework of accounting concepts and principles with emphasis upon the problems of income determination; financial statement presentation and analysis.

262. PRINCIPLES OF ACCOUNTING II. Prerequisite, Economics 261. Three class hours a week. Credit 3 units.

Recording of business operations: acquisitions, payments, and cost classifications; revenue recognition; cash, receivables, and investments; equity accounts of partnerships and corporations; financial statement preparation and interpretation.

[1] From the School of Business and Public Administration.

301. Current Economic Problems: Domestic Issues. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Analysis of selected present-day problems in domestic economic policy.

302. Current Economic Problems: International Relations. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Commercial and financial policies of leading nations in the field of international economic relations, with special emphasis given to contemporary policy of the United States; international economic organizations and their role.

311. Economic Development. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

A comparative study of economic growth and patterns of economic development in the modern world.

315. World Resources and Industries. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Survey of the human and natural resources of the modern world economy; patterns of domestic and international trade; technological change, economic development, and the location of industry.

316. Structure of the American Economy. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Analytical survey of the industrial structure of the American economy, with special attention given to interindustry relations and changing patterns of resource use.

320. History and Problems of Labor. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Population and the labor force; problems of employment, wages, labor productivity, and industrial conflict; development of collective bargaining; role of government in the labor field; human relations in industry.

321. Government and Labor. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Study of state and federal labor laws dealing with wages and industrial relations; effects of government action in these areas upon the economy.

351. Industrial Organizations and Public Policy. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Economic analysis of the American antitrust laws; analytical concepts necessary for understanding the regulation of competition.

381. Principles of Transportation. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

Historical development and present functions of the various transportation agencies; problems of cost allocation and rate making; effects of rate level and structure on the location of economic activity.

ELECTRICAL ENGINEERING

Professors Koopman, Honnell, Zaborszky; Affiliate Professor Winter; Extramural Professor Moore; Associate Professor Cox; Assistant Professor Fisher; Lecturers Binzel, Govro, Harper, Keiser, Ozment, Ross; Instructors Flake, Glaeser, Gregory, Griffith, Guignabodet, Salman, Wann, Wollscheidt

213. DIRECT-CURRENT CIRCUITS. Prerequisite, registration in Mathematics 215. Three class hours a week. First semester. Credit 3 units.

Ohm's and Kirchhoff's laws, calculation of resistance and reduction of networks, mesh current analysis, nodal method of analysis, elements of matrix notation, network theorems, simple transients, magnetic circuits.

298. DIRECT AND ALTERNATING-CURRENT CIRCUITS. Two class hours a week. Credit 2 units.

Elementary circuit theory, resistance of conductors, network reduction, complex number notation, steady-state A.C. calculations, polyphase circuits, measurements.

299. DIRECT AND ALTERNATING-CURRENT MACHINERY. Prerequisite, Electrical Engineering 298. Two class hours a week. Credit 2 units.

Electromagnetic relationships, performance of generators and motors, transformers.

303. ELECTRICAL CIRCUITS LABORATORY I. Prerequisite, registration in Electrical Engineering 213. One laboratory period a week. First semester. Credit 1 unit.

Laboratory exercises designed to show the proper technique in the use of various types of galvanometers, bridges, potentiometers, and similar equipment, the measurement of electric current and potential by means of primary standard, calibration of ammeters, and voltmeters, the performance and reliability of transducers.

305. ELECTRICAL CIRCUITS LABORATORY II. One laboratory period a week. First semester. Credit 1 unit. Concurrent with Electrical Engineering 321.

Laboratory exercises correlated with classroom work of Electrical Engineering 321.

307. DIRECT-CURRENT MACHINERY. Prerequisite, Electrical Engineering 213. Two class hours a week. Second semester. Credit 2 units.

A theoretical treatment of most types of D.C. dynamos, special consideration being given to design features affecting operating characteristics, suitability of the various types of dynamos for particular loads along with control equipment.

314. ELECTRIC, DIELECTRIC, AND MAGNETIC CIRCUITS AND FIELDS. Prerequisite, Electrical Engineering 213, Mathematics 216. Three class hours a week. First semester. Credit 3 units.

Analytical formulation of field problems, field mapping, magnetic and dielectric circuits, concepts of self and mutual inductance, and capacitance.

321. Alternating-Current Circuits I. Prerequisite, Electrical Engineering 213; concurrent with Mathematics 311. Three class hours a week. First semester. Credit 3 units.

Complex number representation of sinusoids, average and effective values, power, impedance, series and parallel circuits, resonance, mesh and nodal analysis, matrix notation, network theorems.

324. Alternating-Current Circuits II. Prerequisite, Electrical Engineering 321. Three class hours a week. Second semester. Credit 3 units.

Coupled circuits, simple transients, polyphase circuits, symmetrical components, Fourier analysis.

331. Direct-Current Machinery Laboratory. Prerequisite, registration in Electrical Engineering 307. One laboratory period a week. Second semester. Credit 1 unit.

Laboratory exercises correlated with classroom work of Electrical Engineering 307.

333. Electrical Laboratory. Prerequisite, registration in Electrical Engineering 299. One laboratory period a week. First semester. Credit 1 unit.

The efficiency and other performance characteristics of D.C. and A.C. generators and motors are determined by actual laboratory test.

336. Electrical Laboratory. Prerequisite, registration in Electrical Engineering 348 or equivalent. One laboratory period a week. Either semester. Credit 1 unit.

Laboratory exercises in machinery and electronics.

348. Electronics. For senior Chemical and Industrial Engineers. Prerequisite, Electrical Engineering 298 or equivalent. Three class hours a week. First semester. Credit 3 units.

Fundamental principles, amplifiers, oscillators.

351-352. Engineering Projects. Elective. Prerequisite, senior standing. Either or both semesters. Maximum credit 3 units.

Laboratory experiments on selected projects with written progress reports and final paper required for credit. Departmental recommendation required.

354. Electronics. Prerequisite, Electrical Engineering 321. Three class hours a week. Either semester. Credit 3 units.

Electron emission, vacuum and gas-filled tubes, introduction to electron ballistics, rectifiers and power supplies, industrial applications.

356. Electronics Laboratory. Concurrently with Electrical Engineering 354. One laboratory period a week. Either semester. Credit 1 unit.

Laboratory exercises correlated with classroom work of Electrical Engineering 354.

358. Direct-Current and Alternating-Current Machinery. For Senior Mechanical Engineers. Three class hours a week. Second semester. Credit 3 units.

Direct-current generators and motors, transformers, synchronous and induction machinery.

361-362. Alternating-Current Machinery Laboratory. Prerequisite, concurrent registration in Electrical Engineering 401 or 402. Two laboratory periods a week. Both semesters. Credit 4 units.

Laboratory exercises in the operation and testing of single and polyphase transformers, alternators, synchronous and induction motors.

401. Alternating-Current Machinery and Distribution Systems. Prerequisite, Electrical Engineering 307, 324. Three class hours a week. First semester. Credit 3 units.

Theory of generators, transformers, distribution circuits, and introduction to induction machines.

402. Alternating-Current Machinery. Prerequisite, Electrical Engineering 401. Three class hours a week. Second semester. Credit 3 units.

Theory and operating characteristics of polyphase induction machines, single-phase motors, synchronous motors, parallel operation.

405. Electrical Circuits Laboratory III. Concurrently with Electrical Engineering 415 and 450. One laboratory period a week. First semester. Credit 1 unit.

Laboratory exercises correlated with classroom work of Electrical Engineering 415 and 450.

411. Elements of Servomechanisms. Elective. Prerequisite, Electrical Engineering 415 or equivalent. Class with laboratory equivalent to three class hours a week. Second semester. Credit 3 units.

Exposition of the concept of feedback applied to automatic control systems. Integration of mathematical, physical, and engineering principles through application to such systems. Steady state and transient analysis of systems which may be described by a linear second order differential equation. Stability of systems.

415. Transients in Linear Networks. Prerequisite, Electrical Engineering 324 and Mathematics 311 or equivalent. Three class hours a week. First semester. Credit 3 units.

Introduction to the classical and Laplace methods of obtaining the response of electric networks characterized by systems of linear differential equations with constant coefficients to arbitrary functions.

418. Power Systems Engineering. Elective. Prerequisite, permission of instructor. Three class hours a week. Second semester. Credit 3 units.

Active and reactive power distribution in the power system. Power system stability. Voltage and reactive power regulation. Load-frequency regulation. Tie line regulation. Asymmetrical and transient conditions on the power system.

421. Communication Engineering. Prerequisite, Electrical Engineering 324 and 354. Three class hours a week. First semester. Credit 3 units.

Analysis of passive and active lumped constant circuits; electric wave filters, impedance matching, measurements of circuit elements, amplifiers.

422. Radio Engineering. Prerequisite, Electrical Engineering 421. Three class hours a week. Second semester. Credit 3 units.

Study of the theory of modulation processes, receivers, amplifiers, transmitters, oscillators; introduction to antennas and propagation.

423. Transistor Electronics. Elective. Prerequisite, Electrical Engineering 384 or 421 or equivalent. One class hour a week. Second semester. Credit 1 unit.

431-432. Communication and Radio Laboratory. Prerequisite, registration in Electrical Engineering 421-422. One laboratory period a week, first semester; two laboratory periods a week, second semester. Credit 1 unit first semester; 2 units second semester.

Laboratory exercises correlated with classroom work of Electrical Engineering 421 and 422.

450. Transmission Line Theory. Prerequisite, Electrical Engineering 314 and registration in Electrical Engineering 421. Three class hours a week. First semester. Credit 3 units.

General theory of electric lines for the transmission of power and signals, transmission line parameters, steady state phenomena, traveling waves.

453-454. Applied Acoustics. Elective. Three class hours a week. Both semesters. Credit 6 units.

Acoustic wave equation for linear fluid media. Propagation of sound waves in tubes. Acoustical impedance, analogous acoustical elements and circuits, generating systems. Driving systems. Microphones and loudspeakers. Electroacoustic measurements.

456. Microwave Techniques. Elective. Prerequisite, Electrical Engineering 450. Two class hours a week and seven laboratory periods a semester. Second semester. Credit 3 units.

Elementary wave-guide theory, wave-guide networks and components, microwave antennas, tubes and resonators.

460. Electronic Computer Design. Elective. Prerequisite, Electrical Engineering 348 or 354. Class and laboratory. Second semester. Credit 3 units.

Design of electronic circuits to perform mathematical operations. Study of electronic components for digital and analog computers. Applications.

ENGLISH

Professor Ringler; Associate Professor Stout; Assistant Professor Campbell; Instructor Black

Composition

101-102. Composition and Rhetoric. Required of all freshmen. Three class hours a week. Both semesters. Credit 6 units.

Review of grammar; analysis of selected readings; expository papers totaling 5,000-6,000 words each semester; required conferences. Stress in second semester on the preparation of a 3,000-word research paper, followed by critical reading of and writing on fiction, drama, poetry. Systematic use of library.

Literature

113. Supervised Reading. Scheduled and conducted by conference. Either semester. Credit 3 units.

371. Values in Literature. Prerequisite, junior standing. Three class hours a week. Either semester. Credit 3 units.

Examination and discussion of selected works of creative literature with the intent of showing Engineering students what the peculiar values and attitudes of literature are. Reading is done at home, and discussion of reading carried on in class.

Speech

211. Fundamentals of Public Speaking. Prerequisite, English Composition 101-102. Three class hours a week. Either semester. Credit 3 units.

Introduction to principles of speech making: organization, evidence, delivery, psychology of the audience. Emphasis on effective communication in oral discourse, formal and informal.

212. Advanced Public Speaking and Persuasion. Prerequisite, Speech 211 or permission of department. Three class hours a week. Either semester. Credit 3 units.

Theories and techniques of persuasion; psychology of audiences.

GENERAL ENGINEERING DRAWING

Professor Grant; Associate Professor Senne; Assistant Professor Amminger; Lecturer Fan; Instructors Craig, Stewart, Goodrich

The department prefers that students have the new type of drawing instruments now used by industry. Therefore the student is urged NOT to purchase a set before attending class.

111. Engineering Drawing. One class hour and two drawing periods a week. Either semester. Credit 3 units.

Orthographic projection; conventional representations; threads and fasteners; springs; pictorial drawing and dimensioning; pencil and ink tracing.

112. Descriptive Geometry. Prerequisite, General Engineering Drawing 111. One class hour and two drawing periods a week. Either semester. Credit 3 units.

Fundamental theory of point, line, and plane; generation of lines and surfaces; intersections and development of solids; application of theory to practical problems; trimetric projection.

213. Advanced Descriptive Geometry. Prerequisite, General Engineering Drawing 112. One class hour and two drawing periods a week. First semester. Credit 3 units.

Stereoscopic drawing; great circle, mining and geological applications; special problems; trimetic projection.

401. Detailing Design. Prerequisite, junior standing. Either semester. Credit 3 units.

Basic design of detailed parts based on ease and economy of manufacture and assembly. Material and problems all derived from industrial practices.

402. Nomography. Prerequisite, junior standing. Either semester. Credit 3 units.

Graphical representation of mathematical formulae through use of alignment and network charts; construction of special slide rules; empirical formulae.

GEOLOGY AND GEOLOGICAL ENGINEERING

Associate Professor Hinchey; Professors Cleaves, Scharon, Tolman; Associate Professors Brice, Johns, Shipton, Werner; Assistant Professor Weeks; Research Associate Echols

101-102. General Geology. Prerequisite, Chemistry 111. Two class hours and one laboratory or field period a week. Both semesters. Credit 6 units.

First semester. Physical Geology: Nature, occurrence, and origin of rocks, configuration of the earth's surface and processes and forces acting upon and modifying it, both externally and internally. *Second semester.* Historical Geology: Historical episodes of earth and its inhabitants as revealed through record in rocks of the earth's crust; succession of physical events, development, and changes in invertebrate, vertebrate, and plant life.

231-232. Mineralogy and Petrology. Prerequisite, General Engineering Drawing 112; prerequisiite or concurrent, Geology 101-102; or permission of instructor. Two class hours and one laboratory period a week. Credit 6 units for the year.

First semester: Morphological crystallography, symmetry, derivation of 32-point group symmetries; crystal chemistry, periodic properties of atoms, atomic size as related to co-ordination, articulation of co-ordination polyhedra; structural-chemical classification of minerals and artificial chemical compounds; structural interpretation of physical and chemical properties of minerals, systematic identification of nonsilicate minerals; confirmatory chemical assaying. *Second semester:* Structural and chemical classification of silicate minerals; systematic determinative study of silicates; geochemical and genetic significance of silicate assemblages and rock textures; study of common igneous, sedimentary, and metamorphic rocks in hand specimen.

321. VERTEBRATE PALEONTOLOGY. Prerequisite, junior standing and Geology 101-102, or 6 units in Botany or Zoology. Three class hours a week. First semester. Credit 3 units.

Study of vertebrate life of past based on fossil record; lessons learned from life of past which explain life of present and future.

322. INVERTEBRATE PALEONTOLOGY. Prerequisite, junior standing and Geology 101-102. Two class hours and one laboratory or field period a week. Second semester. Credit 3 units.

Study of invertebrate life of past based on fossil record; lessons learned from life of past which explain life of present and future.

332. GEMMOLOGY. Prerequisite, junior standing. Three class hours a week. Credit 3 units.

A course in gems, including a systematic study of minerals as they are used for personal adornment and ornamentation. Reference will also be made to gems which are not minerals and to manufactured materials used for gem purposes. The necessary instruments used in identification will be explained and used constantly throughout the course.

341. STRUCTURAL GEOLOGY. Prerequisite, Geology 231-232, Civil Engineering 213; prerequisite or concurrent, Applied Mechanics 201. Two class hours and one laboratory or field period a week. First semester. Credit 3 units.

Architecture of the earth as it is determined by earth movements; geometry and mechanics of geologic folds, faults, primary and secondary structures of sedimentary and igneous rocks; emphasis on recognition of structural features from field data and the interpretation of their origin and significance. Local field trips.

344. FIELD GEOLOGY. Prerequisite, Geology 341 and Civil Engineering 220. Two class hours and one laboratory or field period a week. Second semester. Credit 3 units.

Instruction in methods of the geologist in the field. The student is taught to observe, record, correlate, and interpret geological data in the field, and to prepare formal geologic reports.

365. MINERAL RESOURCES. Prerequisite, Chemistry 111. Three class hours a week. Second semester. Credit 3 units.

Introduction to the principles of physical and historical geology; the origin, geologic and geographic occurrence, uses and reserves of certain mineral deposits; a consideration of methods of exploration for and economic development of these deposits.

367. ENGINEERING GEOLOGY. Two class hours and one laboratory period a week. First semester. Credit 3 units.

Elementary physical geology for engineers. A fundamental and working knowledge of the chief rock-forming minerals is presented, as well as the principal types of sedimentary, metamorphic, and igneous rocks. Weathering, the work of streams, glaciers, winds, and shore-line problems are also considered. Emphasis is placed on the mass movement of soils and ground water.

421. STRATIGRAPHY. Prerequisite, Geology 344. Two class hours and one laboratory or field period a week. First semester. Credit 3 units.

Nature and interpretation of "formations" as used in stratigraphy, bedding planes, unconformities, geochronology, correlation methods, paleography, index fossils; relation to oceanography, ecology, sedimentology, past environments, solution of practical geological problems. Principles of historical interpretation. Field methods and field trips.

422. STRATIGRAPHIC PALEONTOLOGY. Prerequisite, 18 units of Geology, including Geology 322 and 421. One class hour and two laboratory or field periods a week. Second semester. Credit 3 units.

Detailed review of earth history by epoch instead of by period and era, with the introduction of much new material in stratigraphy, regional geology, paleography, regional fauna, and sedimentary facies studies by the epoch. Learning of short range species of invertebrates as guides to short intervals of geologic time. Field work in collecting and identifying index fossils from formations in Missouri, Illinois, Indiana, Kentucky.

425-426. GENERAL MICROPALEONTOLOGY. Prerequisite, Geology 322. One class hour and two laboratory or field periods a week. Either or both semesters. Credit 3 or 6 units.

Review of kinds of animal and plant remains found in microscopic material with reference to classification, ecology, and evolutionary trends within each group; philosophy of classification, and rules of nomenclature; methods of collecting and preparing micro-fossils, and their value as guide fossils in dating the geological age of strata.

427. MICRO-BIO-STRATIGRAPHY. Prerequisite, Geology 421. Two class hours and one laboratory or field period a week. Credit 3 units.

A survey of the more important microscopic guide fossils and of their use in surface and subsurface stratigraphic correlation. Emphasis on the application of the subject rather than on the morphology and taxonomy of the various fossil groups.

431. OPTICAL CRYSTALLOGRAPHY. Prerequisite, Geology 231-232, Physics 221-222, or permission of instructor. One class hour and two laboratory periods a week. First semester. Credit 3 units.

Application of principles of optics to study of natural and artificial crystalline compounds; relationships between crystal structure, chemical composition, and optical constants; identification of crystalline substances by means of the polarizing microscope, crystallographic studies by optical techniques.

434. PETROGRAPHY. Prerequisite, Geology 431. One class hour and two laboratory periods a week. Second semester. Credit 3 units.

Application of the petrographic microscope to the study of rocks; introduction to theoretical petrology.

435. GEOCHEMISTRY I. Prerequisite, concurrent registration in Chemistry 472 or permission of the instructor. Three class hours a week. First semester. Credit 3 units.

Application of physical chemical principles to problems of mineral stability and genesis.

438. Structural Mineralogy. Prerequisite, Geology 431 or permission of the instructor. Two class hours and one laboratory period a week. Credit 3 units.

Special topics in mineralogy; detailed study of special mineral groups; advanced mineralogical techniques. Subject matter will vary from year to year.

451. Geomorphology. Prerequisite, 18 units of Geology or permission of the department. Two one-and-a-half-hour periods a week; occasional field trips. Credit 3 units.

Basic factors in origin and history of landscape considered analytically: architecture of earth's crust, effects of gradational processes, and stage of evolution. Discussions of main problems in geomorphology: quantitative description of landscape, development of slopes, recognition and significance of geomorphic surfaces, effect of different climates on landscape evolution.

461. Geology of Petroleum and Natural Gas. Prerequisite, Geology 341 or permission of the department. Two class hours and one laboratory or field period a week. Credit 3 units.

The nature, origin, migration, accumulation, and occurrence of petroleum and natural gas; exploration and exploitation methods; surface and subsurface techniques of the petroleum geologist.

464. Geology Applied to Modern Construction. Prerequisite, Geology 341, Applied Mechanics 250. Two class hours and one laboratory or field period a week. Second semester. Credit 3 units.

An application of geological principles to heavy construction. Geologic structure, stratigraphy, weathering, etc., in relation to highway and railway construction, tunnels, foundations, etc., are studied in detail. The essentials of subsurface surveys, excavation of soils and rocks; the relationship of soil mechanics, geophysical surveys, and similar methods and techniques are studied. Case histories and practical problems are examined in the field and classroom. Demonstrations are presented.

465. Ground-Water Geology. Prerequisite, Geology 344. Two class hours and one laboratory or field period a week. First semester. Credit 3 units.

A review of the elements of ground-water hydrology. The occurrence of groundwater, and its uses; conditions relative to permeability and porosity, storage, quality of water, recharge pump tests, and similar problems; ground-water exploration, both geologic and geophysical; case history problems related to construction methods.

466. Economic Mineral Deposits. Prerequisite, Geology 341 or permission of the department. Two class hours and one laboratory or field period a week. Credit 3 units.

Geologic description, geographic distribution, and origin of certain metallic and nonmetallic mineral deposits. Detailed discussions of representative economic mineral deposits with attention focused on local geology, form, structure, mineralogy, and origin of the deposits; political and economic aspects of economic mineral resources.

471. Physics of the Earth. Prerequisite, junior standing and consent of the instructor. Three class hours a week. Credit 3 units.

A survey of the problems concerned with the figure and physics of the earth. Topics such as the shape of the earth, the earth's magnetic and gravity fields, its internal structure and temperature, isostasy, age determinations, and tectonophysics will be investigated. Intended for majors and graduate students in geology and for others with a background in any science.

468. Building Stones and Clay Products. For Architects and Architectural Engineers. Two class hours and one laboratory period a week. First semester. Credit 3 units.

A course in general geology that is both cultural and practical, with special emphasis on building stones, clay products, foundations, drainage, and water supply. The student learns the applications of geology to architectural problems and when to call in a qualified consultant.

472. Exploration Geophysics. Prerequisite, Mathematics 211-212, Physics 221-222, Geology 461 or 466. Two class hours and one laboratory or field period a week. Second semester. Credit 3 units.

Introduction to geophysical methods as applied to solution of geological problems: Theory and field procedures of gravimetric, seismic, magnetic, and electrical methods.

500. Independent Work. Prerequisite, 18 units of Geology. Open only to fourth-year students who have a grade-point average for the third year of 2.5 and have been accepted by the chairman of the department. Both semesters. Credit 6 units for the year.

GERMAN

Professor Hofacker; Associate Professor Immerwahr

103-104. Chemical German. Three class hours a week. Both semesters. Credit 6 units.

INDUSTRIAL ENGINEERING

Professors Nadler, Fischer, Gomberg; Associate Professors Hundley, van der Reyden; Assistant Professors Barten, Donovan, Goldman; Instructors Bruckner, Miller; Lecturers Coil, Meltzer

212. Introductory Industrial Engineering. Two class hours a week. First semester. Credit 2 units.

Survey of the phases of Industrial Engineering and their interrelationships.

250. Programming for a Digital Computer. One laboratory period a week. Either semester. Credit 1 unit.

Principles of flow charts, programming, coding, floating point practical checking for errors, symbolic and interpretative programming. Laboratory practice in general nontechnical programs for a digital computer.

301. ENGINEERING STATISTICS. Prerequisite, Mathematics 216. Three class hours a week. Either semester. Credit 3 units.

Classification of observed distributions, analysis of observed and theoretical distributions, correlation analysis, and testing of hypotheses, including chi-square tests, analysis of variance, and t-tests.

305. WORK SIMPLIFICATION. Prerequisite, first semester junior standing and either Accounting or concurrent registration in Accounting. Two class hours and one laboratory period a week. First semester. Credit 3 units.

Philosophy of work simplification and its relationship with engineering. Human factors and how they are handled. Problem solving approach. Concepts of work; techniques for determining the problem and analyzing repetitive and nonrepetitive work. Principles of methods design, motion economy, and evaluation procedures. Research results and techniques in the areas of principle determination and evaluation techniques. Designing, reviewing, testing, and installing proposed methods and procedures control of proposed work conditions. Project in applying work simplification to an industrial activity.

306. WORK MEASUREMENT. Prerequisite, Industrial Engineering 301 and 305. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

Relationship of work simplification and work measurement. Concepts and problems of standards setting. Labor attitudes and statistical bases for work load determination. Defining qualitative components to be measured. Measurement techniques for timing and rating operator performance. Research in areas of operator performance and job effects on operator. Measuring job difficulty. Concepts and types of allowances. Elemental standard data construction. Basic motion standard data (predetermined motion-time systems). Control of individual measurements in time study and of whole standard time. Installation of standard time and associated problems.

310. ENGINEERING ECONOMY. Three class hours a week. Either semester. Credit 3 units.

Planned versus hunch decisions. Relative economy of alternatives. Calculation of annual cost, present value, and prospective rates of return. The economic effects of interest and taxation; depreciation and obsolescence of physical property; intangible values. Economy of design, selection, operation, and replacement of buildings, equipment, etc. Economy studies for public works and individual or social effect on economy studies. Engineering reports and budgets.

370. MECHANIZATION METHODS. Prerequisite, Mechanical Engineering 311 and Industrial Engineering 305. One class hour and one laboratory period a week. Second semester. Credit 2 units.

Development and design of machinery, tools, and gages for production operations. Cutting speeds and feeds. Shearing, stamping, forming forces and dies. Workplace location and clamping. Production tolerances, cost estimating, cutting tools. Tool design in general. Fixtures and jigs. Punches and dies.

380. Industrial Organization. For junior or senior Engineers other than Industrial. Three class hours a week. Either semester. Credit 3 units.

A general survey of the staff functions in the industrial plant. An analytical approach to the solution of problems in the fields of work simplification and measurement, cost analysis and controls, quality control, and production planning and control.

382. Industrial Engineering Field Trips. Prerequisite, Industrial Engineering senior standing. One laboratory period a week. Second semester. Credit 1 unit.

Inspection trips to various plants in diversified industries in the area to obtain a well-rounded knowledge of applications of industrial engineering. Brief reports required to summarize observed activities.

390. Collective Bargaining for Engineers. Prerequisite, junior or senior standing. Two class hours and one conference hour a week. Either semester. Credit 3 units.

An introductory course to a study of the relationship between the management and the worker at the plant level. This will include a study of the dynamics of the trade union institution at both the national and local levels and its resulting plant effects.

408. Motion and Time Study. Prerequisite, Economics 211 and second-semester junior standing. Four class hours a week. First semester. Credit 4 units.

Techniques, methods, and uses of motion and time study in the industrial and management situation. Includes work simplification and work measurement. Application and practice with the techniques. The interrelationship of the techniques and their uses in the entire field of Industrial Engineering.

410. Technical Sales. Three class hours a week. Second semester. Credit 3 units.

Marketing of industrial and business goods. Emphasis on marketing principles, policies, channels of distribution, organization, purchasing, advertising, and sales engineering, to give students a background for actual industrial sales jobs and an understanding of marketing problems necessary in any executive position.

411. Human Relations in Industry. Prerequisite, senior standing. Three class hours a week. Either semester. Credit 3 units.

A course devoted to the development of the student's ability to analyze and discuss human relations problems as presented by the case method. The cases cover all levels of management and many varied situations which have occurred in industry. The relationship between human relations and job evaluation is analyzed. Problems which pertain to all branches of engineering are discussed. Seminars and conference leading are demonstrated.

419. Safety Engineering. Prerequisite, senior standing. Two class hours a week. First semester. Credit 2 units.

Procedures for the analysis of causes of accidents, computing accident costs, evaluation of accident control problems in industry, the elements of the industrial safety program, and typical control measures for promoting safe practices. Safety problems in atomic activities.

421. Engineering Law. Prerequisite, second-semester junior standing. Two class hours a week. Either semester. Credit 2 units.

A survey of the law of contracts, agency, workmen's compensation; patents and trade-marks; registration for engineers and architects, and other subjects affecting engineers and architects.

424. Plant Layout and Materials Handling. Prerequisite, Industrial Engineering 305. One class hour and two laboratory periods a week. First semester. Credit 3 units.

Application of detailed engineering approach to the solution of plant layout and materials handling problems. Determination of goals; revision of existing layouts; layouts for new products or building. Techniques for analysis of problem. Principles of plant layout and materials handling. Automation concepts. Materials handling equipment. Factors involved in selection of industrial location and building. Evaluation of alternative solutions. Layout technique. Actual solution of practical plant layout and materials handling problems from industry.

433. Preparation for Manufacture. Prerequisite, Industrial Engineering 370; concurrent registration in Industrial Engineering 424. One class hour and one laboratory period a week. First semester. Credit 2 units.

The nature of decisions made during production planning will be explored. The concept of incorporating provisions for effective control of cost, quality, and quantity in product designs, process, plant, tool designs, methods, and plant layout will be stressed. An important aim of the course is to seek ways of tempering the technical approaches of the product-design engineer with production management considerations before designs, processes, and layouts are frozen.

444. Work Simplification for Hospital Administration. Prerequisite, registration in hospital administration program. Three class hours a week. Second semester. Credit 3 units.

Philosophy and concepts of work. History and applications of work simplification in diverse areas. Problem-solving approach for work simplification. Techniques for analyzing work, obtaining suggestions for improving work, evaluating different procedures, detailing final design, and installation of proposals. Illustrations of hospitals and hospital-type activities. Relationship of work simplification to measurement of work and control of work activity. Integration of work simplification philosophy into administrative techniques.

450. Computers and Data Processing. Prerequisite, Mathematics 405 and senior standing. One class hour and one laboratory period a week. Second semester. Credit 3 units.

Survey of general field of automatic computers, covering both digital and analog machines. Logic of computers, binary numbering system. Application of computers to problems in industrial engineering.

452. Production Control. Prerequisite, Industrial Engineering 433. Two class hours a week. Second semester. Credit 2 units.

Building sales and production forecasts. Scheduling production in the industrial organization, including master scheduling and machine loading. The theory and calculations of economic lot sizes. The fundamental techniques of dispatching, follow-up, and control of inventory and purchasing. The concept of control over the manufacturing facilities as obtained through the use of communication devices.

457. Statistical Quality Control. Prerequisite, Industrial Engineering 301. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

Application of statistical techniques to control of processes and to receiving inspection. Control charts for process analysis and acceptance sampling methods for receiving inspection. General concepts of sampling analysis.

460. Special Projects in Industry. Prerequisite, Industrial Engineering 305-306 or Industrial Engineering 408 and permission of the department. Credit and time to be arranged.

494. Industrial Engineering Problems. Prerequisite, Industrial Engineering 433. Second semester. Three class hours a week. Credit 3 units.

Through the media of case problems, applied research, plant visits, and lectures, an analysis of production processes will be made to form a basis for understanding such problems as automation, process planning, product design, methods, control systems, wage incentives, and supervision. Relationship of industrial engineering problems to organization budgets, ownership, etc. Design of over-all solutions to specific industrial problems.

MATHEMATICS

Professors MacNeille, Downs, Haimo, Hirschman, Middlemiss; Visiting Professor Cotlar; Associate Professors Devinatz, Elliott, Goldhaber, Kokoris, Schaerf, Van Schaack; Assistant Professors Feldman, Nussbaum; Instructors Askey, D. Haimo, Lachterman, Mahoney

115-116. College Mathematics. Prerequisite, 3 years of high school mathematics, including at least 1½ years of algebra and 1 year of geometry. Five class hours a week. Credit 10 units for the year, but a grade of C or better in Mathematics 115 is prerequisite for Mathematics 116.

Algebra, trigonometry, analytic geometry and an introduction to the calculus.

Students who have had thorough high school training in algebra and trigonometry should apply for a proficiency examination. Those who qualify may omit Mathematics 115 and register for Mathematics 116 or Mathematics 117.

117-118. Introduction to Mathematical Analysis I. Prerequisite, placement test or consent of the department. Five class hours a week. Credit 10 units for the year, but a grade of C or better in Mathematics 117 is prerequisite for Mathematics 118.

For entering students with superior training or aptitude in mathematics. The course provides an early introduction to the calculus and analytic geometry; it also covers essential topics in algebra and trigonometry not normally covered in four years of mathematics in high school. Mathematics 117 starts at a more advanced level than Mathematics 115; the three-semester sequence, Math 117, 118, 217, provides training equivalent to the four-semester sequence, Math 115, 116, 215, 216.

215. The Calculus I. Prerequisite, Mathematics 116 with a grade of C or better. Four class hours a week. Credit 4 units.

Continuation of Mathematics 116. Differential and integral calculus. Not open to students who have had no calculus.

216. The Calculus II. Prerequisite, Mathematics 215 with a grade of C or better. Four class hours a week. Credit 4 units.

217. Introduction to Mathematical Analysis II. Prerequisite, Mathematics 118 with a grade of C or better. Four class hours a week. Credit 4 units.

A continuation of Mathematics 117-118.

301-302. Modern Mathematics. Prerequisite, junior or senior standing and consent of the instructor. It is desirable that students shall have completed Mathematics 104 or 116. Three class hours a week. Both semesters. Credit 6 units.

311. Elementary Differential Equations. Prerequisite, Mathematics 216 or 217 with a grade of C or better. Three class hours a week. Credit 3 units.

312. Applied Calculus. Prerequisite, Mathematics 311. Three class hours a week. Credit 3 units.

Topics in vector analysis, line and surface integrals, partial differential equations, and functions of a complex variable.

331. Techniques of Algebra. Prerequisite, Mathematics 118 or 215 with a grade of C or better. Three class hours a week. Credit 3 units.

332. Higher Algebra II. Prerequisite, consent of the instructor. Three class hours a week. Credit 3 units.

401. Statistics I. Prerequisite, Mathematics 215, 118. Three class hours a week. Credit 3 units.

402. Statistics II. Prerequisite, Mathematics 401. Three class hours a week. Credit 3 units.

403. Introduction to Numerical Anaylysis I. Prerequisite, Mathematics 216 or 217. Three class hours and one laboratory period a week. Credit 4 units.

The basic procedures of computations, including interpolation, numerical integration, differentiation, summation of series, solution of simpler types of algebraic and differential equations.

404. Introduction to Numerical Analysis II. Prerequisite, Mathematics 403. Three class hours and one laboratory period a week. Credit 4 units.

Continuation of Mathematics 403.

405. Introductory Mathematical Programming. Prerequisite, Mathematics 216 and a course in statistics. Two class hours a week. Credit 2 units.

Optimization studies, maximization of profits and minimization of cost. Concepts of linear programming theory of games, queueing theory, and other "operations research" techniques in industrial problems.

413. Advanced Calculus I. Prerequisite, Mathematics 216 or 217 with a grade of C or better. Three class hours a week. Credit 3 units.

Vector analysis, partial differentiation, extreme values of functions of several variables, line and surface integrals.

414. Advanced Calculus II. Prerequisite, Mathematics 413 with a grade of C or better; or for those who have not previously taken Mathematics 413, Mathematics 216 or 217 with a grade of B or better. Three class hours a week. Credit 3 units.

Series, improper integrals and the gamma and beta functions, Stirling's formula, Fourier series and orthogonal functions with applications.

416. Elementary Topics in the Theory of Functions of a Complex Variable. Prerequisite, Mathematics 414 with a grade of B or better. Three class hours a week. Credit 3 units.

Analytic functions; elementary functions and their properties. Line integral; the Cauchy integral formula. Power series; residues; poles. Conformal mapping and applications.

419. The Laplace Transform. Prerequisite, Mathematics 416. Three class hours a week. Credit 3 units.

The fundamental properties of the Laplace transform in the complex domain, from the point of view of applications to engineering and physics.

435. Elementary Theory of Numbers. Prerequisite, Mathematics 216 or 217. Three class hours a week. Credit 3 units.

Divisibility properties of integers, congruences, quadratic residues.

436. Analytical Theory of Numbers. Prerequisite, Mathematics 435 and 416 or consent of instructor. Three class hours a week. Credit 3 units.

The prime number theorem and the zeta function, character sums and arithmetic progressions, partitions and circle method.

471-472. Topics in Applied Mathematics. Prerequisite, 6 units of credit in Advanced Calculus. Three class hours a week. Credit 6 units for the year.

491-492. Introduction to Mathematical Statistics. Prerequisite, Mathematics 311. Three class hours a week. Credit 6 units for the year.

Derivation of fundamental formulas used in statistics and illustrations of their use in making statistical inferences.

493. Probability I. Prerequisite, Mathematics 215 or 118. Three class hours a week. Credit 3 units.

Theory and application of mathematical probability.

494. Probability II. Prerequisite, Mathematics 493. Three class hours a week. Credit 3 units.

Continuation of Mathematics 493.

MECHANICAL ENGINEERING

Professors Kippenhan, Georgian, Gulbransen; Associate Professor Hoelscher; Visiting Associate Professor Van Camp; Assistant Professors Holladay, Ong; Lecturers Coad, Diboll, Lance, Wolak; Instructor Scheuner

210.* Metal Machining. For Mechanical, Electrical, Industrial, and Geological Engineers. One laboratory period a week. Either semester. Credit 1 unit.

The fundamentals and principles of machine shop practice. Drilling, sawing, turning, and boring practice. Threads and thread cutting. Shaping and allied processes.

214. Elements of Mechanisms. Prerequisite, General Engineering Drawing 111; corequisite, Mathematics 215. Two class hours and one drawing period a week. Either semester. Credit 3 units.

Kinematic principles of mechanisms, including the theory of their forms, displacements, velocities, and accelerations; study of bar linkages, cams, gears, gear trains, intermittent-feed devices, straight-line mechanisms, and others encountered in engineering practice.

247. Physical Metallurgy. Prerequisite, Chemistry 111. Two class hours and one laboratory period a week. Either semester. Credit 3 units.

Study of the structure, constitution, and uses of metals and alloys; theory of heat treatment and elementary alloying and their effects on properties and uses. Laboratory work in grinding, polishing, etching, and microscopic examination of metals and alloys. Related experiments in hardness testing, cooling curves, and equilibrium diagrams.

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* Courses marked with an asterisk are supported in part by the William and Jessie R. Barr Fund for the support of the Manual Training School, which was established under the charter of Washington University in 1879 and discontinued in 1917.

305.* Welding and Heat Treatment. One laboratory period a week. Either semester. Credit 1 unit.

Gas and electric welding, soldering, brazing, and hard-surfacing, and their application in industry. Mechanical and heat-treatment of metals. Principles of hardening, annealing, tempering, and normalizing of steel. The use of the iron-carbon diagram. The effect of the principal alloys in heat treatment of steel.

311.* Machine Shop. For Mechanical and Industrial Engineers. Prerequisite, Mechanical Engineering 210. Two laboratory periods a week. Either semester. Credit 2 units.

Advanced machine shop work, turret lathes, screw machines, grinding, broaching, milling, tools, jigs and fixtures. Production methods in the shop.

312.* Production Methods. For Mechanical Engineers. Prerequisite, Mechanical Engineering 311 and 305. One class hour and one laboratory period a week. Second semester. Credit 2 units.

The principles of interchangeable manufacturing, standardization product analysis; jig fixture and tool design, routing and inspection procedure, time studies and estimates; control of stores, safety, etc.

320. Machine Design. For Industrial Engineers. Prerequisite, Mathematics 216 and Applied Mechanics 201. Three class hours and one laboratory period a week. Second semester. Credit 4 units.

Simple stress and strain; shear and bending moment diagrams for beams; stress and deflection of beams. Shearing stresses; stress concentration and endurance diagrams. Torsion, shafting, keys and couplings. Helical springs. Bolted, riveted, and welded connections. Spur, helical, and bevel gears, belts. Lubrication. Assigned problems.

321-322. Machine Design. Prerequisite, Mechanical Engineering 214, Mathematics 216, and Applied Mechanics 250. Two class hours and one laboratory period a week. Both semesters. Credit 6 units.

Review of strength of materials. Mohr's circles. Design of beams, shafting, keys and couplings. Stress concentration, endurance limits. Screw and bolted joints. Helical, leaf and rubber springs. Belt and chain drives. Clutches and brakes. Welded and riveted joints. Spur, bevel, and worm gears. Lubrication, ball and roller bearings. Assigned problems. Vibration, critical speeds, and balancing of rotors and engines. Engine dynamics, tangential effort diagrams, bearing load analysis. Torsional vibration of engines.

323-324. Thermodynamics. Prerequisite, Physics 211 and Mathematics 216. Three class hours a week. Both semesters. Credit 6 units.

Classical thermodynamics, the first and second law, properties of gases, vapors, and liquids. Application of the basic principles to engineering systems, mixtures, reactive systems, power and refrigeration cycle analyses.

334. Mechanical Engineering Laboratory. To be taken concurrently with Mechanical Engineering 370. One laboratory period a week. Second semester. Credit 1 unit.

Study of pressure, temperature, and flow-measuring devices; testing of steam engines, nozzles, drag and lift measurements.

370. Flow of Fluids. Prerequisite, Mechanical Engineering 323, Applied Mechanics 303. Three class hours a week. Second semester. Credit 3 units.

Modern theory of fluid flow; continuity, energy and momentum relationships for steady flow. Dimensionless analysis. Flow in pipes, nozzles, and orifices. Drag and lift. Compressibility effects.

371. Principles of Heat Transfer. Prerequisite, Mechanical Engineering 370. Three class hours and one laboratory period a week. First semester. Credit 4 units.

A study of the principles of heat transmission with application to basic mechanical engineering operations and equipment. Steady state conduction in one and two dimensions. Data correlations for forced and free convection transfer. Boiling and condensation. Mean temperature differences and over-all heat transfer. Unsteady state conduction.

372. Topics in Heat Transfer. Prerequisite, Mechanical Engineering 323. Three class hours a week. Second semester. Credit 3 units.

A study of the three heat transfer mechanisms, conduction, convection, radiation. Engineering application of these principles to analysis and design of systems. Conduction with heat generation, heat dissipation.

382. Heating and Air Conditioning. For senior Architectural Engineers. Three class hours a week. Second semester. Credit 3 units.

A study of basic thermodynamics and heat transfer as applied to the heating and cooling of air. Methods of calculation of heat loss and cooling load on residences and commercial buildings. Discussion of various systems of heating and air conditioning, together with a study of competent equipment of these systems.

391. Reciprocating Engines and Compressors. Prerequisite, Mechanical Engineering 323-324; corequisite, Mechanical Engineering 322. Three class hours and one laboratory period a week. Either semester. Credit 4 units.

Theoretical and practical aspects of the cycles of positive displacement pumps, compressors, and internal combustion engines. Balancing and the study of vibrations related to reciprocating machinery. Power tests of spark ignition and compression ignition engines according to Society of Automotive Engineers Standards. Tests to determine the effect of variables on the operation of engines and other reciprocating machinery.

392. Turbomachinery. Prerequisite, Mechanical Engineering 323-324. Three class hours and one laboratory period a week. Either semester. Credit 4 units.

Brief review of fluid mechanics and thermodynamics with reference to turbomachinery. Hydraulic turbines; steam and gas turbines; Euler's turbine equation; principles of dynamic similarity, specific speed. Cavitation. Converging and diverging nozzles. Impulse and reaction stages. Centrifugal pumps and compressors; vortex theory, specific speed. Axial flow pumps and compressors. Torque converters. Stress and vibration of principal parts. Assigned problems. Laboratory tests to determine the characteristics of centrifugal pumps, hydraulic turbines, steam and gas turbines. Axial and centrifugal compressors; fans and blowers.

395. Heat Transfer Equipment. Prerequisite, Mechanical Engineering 371. Three class hours and one laboratory period a week. Second semester. Credit 4 units.

Application of principles of heat transfer and fluid flow to heat transfer equipment. Design of contact and surface heaters, boilers, superheaters, liquid coolers, and refrigeration heat exchangers, cooling towers, and evaporative condensers. Assigned problems. Laboratory work consists of tests of various heat exchange equipment and the design of specific equipment.

399. Mechanical Engineering Seminar. Prerequisite, senior standing. One class hour a week. Credit 1 unit.

This seminar includes the practice of outlining and verbally presenting technical information. A conference with the adviser is required before and after each talk.

421. Advanced Machine Design. Prerequisite, Mechanical Engineering 322. Two class hours and one design period a week. Either semester. Credit 3 units.

Advanced machine design problems in thick cylinders, force and shrink fits, rotating blades and disks. Curved beams. Open coiled springs, disk and belleville springs, spiral springs. Hydrodynamic theory of lubrication. High speed ball and roller bearings. Eccentrically loaded bolted joints. Mohr's circle in three dimensions. Photoelasticity applied to design. Flat rectangular and circular plates. Mechanical seals. Assigned problems.

431. Plant Engineering. Prerequisite, senior standing. Three class hours a week. First semester. Credit 3 units.

A study of the problems involved in providing maintenance and utility services in an industrial organization. Topics presented include: Plant engineering department organizations; maintenance procedures, costs, and record keeping; selection of utilities distribution systems; illumination; corrosion protection; ventilation; and fire protection systems.

447. Ferrous Metallurgy. Prerequisite, Mechanical Engineering 247. Two class hours and one laboratory period a week. First semester. Credit 3 units.

Metallography of iron and steels; heat treatment of steels; selection and design of metal machine parts; inspection and testing hardness, hardenability, etc., and the production of iron and steels.

448. Nonferrous Metallurgy. Prerequisite, Mechanical Engineering 247. Two class hours and one laboratory period a week. Second semester. Credit 3 units.

Metallography of nonferrous metals and alloys — copper, aluminum, bearing metals, die-casting alloys, selection and design of nonferrous metal parts, inspection, testing, and the production of nonferrous metals.

451. Analysis of Mechanical Engineering Problems. Prerequisite, Mechanical Engineering 322 and 370. Three class hours a week. First semester. Credit 3 units.

Study of a wide variety of typical engineering problems with special emphasis on individual initiative, especially with regard to method of attack and assumptions to be made.

452. Analysis of Mechanical Engineering Problems. Prerequisite, Mechanical Engineering 451 and consent of department. Three class hours a week. Second semester. Credit 3 units.

Analysis of mechanical engineering problems in heat transfer (temperature distributions in various shapes); vibrations (governor mechanisms used in the control of rotating shafts); fluid mechanics (development of the momentum equation for an acceleration volume with application to rockets, jets, and turbines); machine design (computation of thermal stresses in internal combustion engine components).

453. Instrumentation and Controls. Prerequisite, Mechanical Engineering 322, 370. Two class hours and one laboratory period a week. Credit 3 units.

Basic automatic control theory is studied with emphasis on controlled systems rather than controllers alone. Typical system elements are considered both in classroom and laboratory. Analog computer methods are introduced briefly.

491-492. Special Problems in Mechanical Engineering. Prerequisite, senior standing and consent of the department. Credit 1 to 3 units each semester.

Individual laboratory or library investigations of selected problems in Mechanical Engineering.

METALLURGICAL ENGINEERING

201. Engineering Materials. Prerequisite, Chemistry 111. Two class hours a week. First semester. Credit 2 units.

A study of the most important properties of ordinary materials, including metals, inorganic nonmetallics, organic materials. A description of fabrication and methods of testing.

301. Physical Metallurgy. Prerequisite, Metallurgical Engineering 201. Three class hours a week. First semester. Credit 3 units.

Study of structure, constitution, and industrial uses of metals and alloys. Theory of heat treatment and alloying.

302. Physical Metallurgy. Prerequisite, Metallurgical Engineering 301. Three class hours a week. Second semester. Credit 3 units.

Applications of thermodynamics, kinetic theory, atomic and crystal structure to problems in metallurgy.

303. Metallurgy Laboratory. Concurrent registration in Metallurgical Engineering 301. One laboratory period a week. First semester. Credit 1 unit.

Laboratory work in the microscopic examination of metals and alloys. Methods of constructing equilibrium diagrams. Fundamentals of foundry practice.

304. Metallurgy Laboratory. Concurrent registration in Metallurgical Engineering 302. One laboratory period a week. Second semester. Credit 1 unit.

Determination and calculation of thermodynamic properties, rate constants, and crystal structures of metallurgical interest.

410. Nonferrous Metallurgy. Prerequisite, Metallurgical Engineering 302 and 304. Three class hours a week. Second semester. Credit 3 units.

The production and properties of commercially important metals such as copper, lead, zinc, and titanium. Outline of conventional production techniques. Properties and commercial use of the nonferrous metals.

411. Metallurgy of Iron and Steel. Prerequisite, Metallurgical Engineering 302 and 304. Three class hours a week. First semester. Credit 3 units.

Production methods for iron and steel, including the blast furnace, open hearth, and electric furnace. Properties, heat treatment, mechanical working of low and high alloy steels.

423. Metallurgy Laboratory. Concurrent registration in Metallurgical Engineering 411. One laboratory period a week. First semester. Credit 1 unit.

Heat treatment and microscopic examination of cast irons and steels. Macroscopic examination of cast irons and steels.

PHILOSOPHY

305. Fundamentals of Philosophy. For Engineers. Prerequisite, senior standing. Three class hours a week. Second semester. Credit 3 units.

Introduction to basic questions concerning man's world and his place in it, with special reference to problems of knowledge, of the natural world, and of society and values.

PHYSICAL EDUCATION

Associate Professor Burrus; Professors Drew, Snavely; Associate Professors Melin, Noble, Summers; Assistant Professors Avery, Hovland, Utz; Instructors Gullion, Vento

PHYSICAL EDUCATION FOR MEN

101-102. Physical Education. For first-year students. Three class hours a week. Both semesters. Credit 2 units.

Conditioning activities and instruction and practice in fundamental skills, team sports, and elementary swimming.

201-202. PHYSICAL EDUCATION. For second-year students. Three class hours a week. Both semesters. Credit 2 units.

Instruction and practice in the techniques and tactics of individual and dual sports.

PHYSICAL EDUCATION FOR WOMEN

101-102. PHYSICAL EDUCATION. For first-year students. Three class hours a week. Both semesters. Credit 2 units.

A program of elective activities consisting of archery, badminton, basketball, dance, field hockey, golf, softball, swimming, tennis, and volleyball. Elementary and advanced sections.

201-202. PHYSICAL EDUCATION. For second-year students. Three class hours a week. Both semesters. Credit 2 units.

Advanced program which emphasizes knowledge, techniques, and strategy of activities listed under 101-102.

PHYSICS

Professors Condon, Compton, Feenberg, Norberg, Primakoff, Sard, Varney; Professor Emeritus Hughes; Associate Professors Pond, Shull, Townsend; Assistant Professors Fowler, Friedlander, Lambe; Research Associates Daehnick, Haller, Hurley, Rosen

105-106. GENERAL PHYSICS. Prerequisite, high school algebra, plane geometry, and trigonometry. Three class hours and one laboratory period a week. Credit 8 units for the year. Physics 105-106, with Physics 225, may be offered as prerequisite for advanced study in Physics. A student may not have credit for both Physics 105-106 and 220-221-222.

First semester: mechanics, electricity. *Second semester:* heat, light, atomic physics.

117-118. GENERAL PHYSICS. Prerequisite, high school algebra, plane geometry, and trigonometry. Three class hours and one laboratory period a week. Credit 8 units for the year.

First semester: Mechanics, electricity and magnetism, kinetic theory. *Second semester:* Wave motion, physical and geometrical optics, atomic physics.

220. ELEMENTARY MECHANICS AND PROPERTIES OF MATTER. Prerequisite, completion of or concurrent registration in Mathematics 116 or the equivalent. Two class hours a week. Credit 2 units.

A first course in physics with intensive drills on problems. The use of calculus is brought in as the students advance in the concurrent mathematics course.

221. ELECTRICITY, MAGNETISM, WAVE MOTION. Prerequisite, Physics 220 and completion of or concurrent registration in Mathematics 215. Three class hours and one laboratory period a week. Credit 4 units.

Continuation of Physics 220 using integral calculus more extensively and applying the fundamentals of mechanics to electricity and magnetism and to wave motion.

222. Heat, Sound, Light, Modern Physics. Prerequisite, Physics 221. Three class hours and one laboratory period a week. Credit 4 units.

Application of wave motion to sound and light. Introduction to the elements of particle and electron physics.

225. Modern Physics. Prerequisite, Physics 105-106. Three class hours a week. Credit 3 units.

Selected topics dealing with the physics of atoms, atomic nuclei, and fundamental particles.

321. Intermediate Laboratory I. Prerequisite, Physics 105-106 or 221-222, and 6 units of mathematics, including Mathematics 115. One laboratory and one discussion period a week. Credit 2 units.

Twelve experiments in mechanics, heat, electricity, optics, and modern physics.

322. Intermediate Laboratory II. Prerequisite, Physics 321 or consent of the instructor. One laboratory and one discussion period a week. Credit 2 units.

Twelve experiments in mechanics, heat, electricity, optics, and modern physics.

411. Mechanics. Prerequisite, Mathematics 216 and Physics 221-222, or Physics 105-106 and 225, with a grade of B or better. Three class hours a week. Credit 3 units.

Motion of particles in one dimension; energy integral; period of oscillatory motion; simple harmonic motion with damping; forced vibrations; motion in two and three dimensions; two-particle problem; inverse square force; Kepler's laws; Rutherford scattering laws; conservation laws; motion of rigid body; symmetrical top; coupled vibrations; Lagrangian equations of motion.

412. Heat and Thermodynamics. Prerequisite, Mathematics 216 and Physics 221-222, or Physics 105-106 and 225, with a grade of B or better. Three class hours a week. Credit 3 units.

Specific heats; thermometry; 1st and 2nd laws; reversibility and irreversibility; entropy; other thermodynamic functions; applications to physical and chemical systems; elements of statistical mechanics.

421-422. Electricity and Magnetism. Prerequisite, Mathematics 216 and Physics 211-212, or Physics 105-106 and 225, with a grade of B or better. Three class hours a week. Credit 6 units for the year.

Electrostatics; properties of dielectrics and conductors; magneto-statics; steady conduction; magnetic effects of steady currents; motions of ions in electric and magnetic fields; electromagnetic induction; vector methods; elements of electronics and A.C. and D.C. circuits; Maxwell field equations and their plane-wave solutions.

451. Experimental Techniques I. Prerequisite, Physics 421-422. Two laboratory periods a week. Credit 2 units.

Properties and applications of vacuum tubes; amplifier, oscillator, power-supply circuits; pulse-forming networks; thermionic emission; gas-discharge tubes; vacuum systems; Geiger counters; statistics of counting; coincidence circuits.

452. Experimental Techniques II. Prerequisite, Physics 421-422. Two laboratory periods a week. Credit 2 units.

Continuation of Physics 451.

461. Radiation and Optics. Prerequisite, Physics 421-422. Three class hours a week. Credit 3 units.

Mathematics of wave motion; electromagnetic wave motion in a vacuum; electromagnetic wave motion in media; polarization; interference; diffraction; dispersion; sources of radiation; transmission of radiation; detection of radiation.

462. Mechanics of Continuous Media. Prerequisite, Physics 411 and senior standing. Three class hours a week. Credit 3 units.

Introductory study of elasticity, hydrodynamics, and acoustics, with special emphasis on associated mathematical methods; treatment of stress, flow, and wave propagation by vector, tensor, and matrix procedures; analysis of initial-, boundary-, and eigen-value problems in the corresponding partial differential equations; elementary use of eigen-function expansions.

471-472. Atomic, Nuclear, and Solid State Physics. Prerequisite, Physics 411, 412, and 421-422, or permission of the department. Three class hours a week. Credit 6 units for the year.

Introduction to the basic quantal ideas of atomic structure; extension of these ideas, where possible, to nuclear structure; description of properties of nuclei and fundamental particles; molecular structure as an introduction to the behavior of aggregates of atoms; the classes of solids and the relation of their properties to those of constituent atoms and nuclei.

500. Independent Work. Prerequisite, senior standing and permission of the chairman of the department. Credit to be determined in each case; maximum credit 6 units.

FINANCIAL REGULATIONS

The University reserves the right to change the fees herein stated, or to establish additional fees, at any time, without notice. Whenever such changes or additions are made, they become effective as to the next installment for payment due from the student.

All fees and deposits are payable in advance at the time of registration. Payments are made in the office of the Treasurer. All students are liable for the full tuition for each semester.

Nonpayment of obligations in respect to tuition or other expenses due the University or otherwise affecting the University will be cause for refusal of graduation, registration, or transfer of credits.

Washington University feels that its students and their parents will appreciate knowing that the University does not charge its students the full cost of their education. Although the specific amount varies in the different schools, the tuition covers, on the average, only about one-half of the instructional cost which the University must bear in the education of each student. The balance of this cost of instruction must be met by income from endowment funds, and the gifts of alumni, corporations, and other friends of this University.

TUITION

The regular tuition fee is $450 a semester for students taking twelve or more units of work. Students taking fewer than twelve units a semester shall pay a tuition fee of $35 a unit. Tuition is payable at the beginning of each semester.

The tuition of $450 a semester may be paid in four installments if application is made and approved prior to registration. The payment schedule on this plan is as follows:

Fall	*Spring*		*Amount*
At registration	At registration		$125.00
		Service charge	5.00
			$130.00
November 1	March 1		125.00
December 1	April 1		125.00
January 2	May 1		75.00

Application for this deferment plan should be made in person at the Student Aid Office in the Student Activities Building either on the day of registration or during the week prior to the registration days. Payments must be made as scheduled or the registration will be cancelled. Special problems should be discussed with the Student Aid Office prior to the dates on which payments are due.

Korean veterans may make application for a deferred tuition plan especially arranged in accordance with the dates government checks are received. Application must be made at the Washington University Veterans Office prior to registration.

Washington University offers for the consideration of parents The Insured Tuition Payment Plan. In addition to a convenient schedule of monthly payments of tuition, this plan provides death or total disability insurance on the parent. A detailed description of this Insured Tuition Payment Plan may be had from the Office of Admissions upon request.

Students who pay the regular tuition fee of $450 a semester may, upon the recommendation of the deans of the schools concerned, take one or more courses in another school without extra charge. Students who pay less than the normal tuition of $450 a semester must pay for work taken in another school at the regular rate for single courses.

SPECIAL SERVICE FEES

Special Examination

A charge of $3.00 is made for any examination taken at other than the scheduled time. Arrangements should be made through the Office of the Dean.

Changes in Registration

Changes in registration, after the student's cards have been checked by and deposited with the final checking clerk, may be made only with the approval of the Dean, and then only after the payment of a fee of $2.00 for each course changed.

Late Registration

Students who fail to register and pay their fees on any of the days set apart for that purpose are required to pay a fee of $5.00.

Transcripts

For each transcript or copy of record after the first one issued, the student is charged $1.00. Transcripts may be obtained from the Office of Student Records.

REFUNDS

A request for a refund will be considered when it is made to the Dean in writing, and no student can be officially withdrawn except on the approval of the Dean. The date on which the student's written request is received by the Dean is regularly used in the making of tuition adjustments. A student who officially withdraws within the first

week of classes will be charged 20% of the semester's tuition; a student who withdraws after the first week and before the end of the second week will be charged 30% of the semester's tuition; a student who withdraws after the second week and before the end of the fourth week will be charged 40% of the semester's tuition; and a student who withdraws after the fourth week and before the end of the eighth week will be charged 60% of the semester's tuition. There is no refund of any portion of the tuition fee after the eighth week of the term. No special fees are refundable after the second week. There is no refund on the dropping of individual courses.

STUDENT AID

The University offers a comprehensive program of student aid and counseling regarding financial problems. The various forms of student aid are described in the following sections: Scholarships; Loans; Deferred Tuition; Part-time Employment.

SCHOLARSHIPS

A number and variety of scholarships have been established by the University from time to time to aid deserving and needy students. Certain of these funds are available to students in all the degree-conferring divisions of the University. Other funds are limited to students in particular schools or divisions, to men or women, to first-year or upperclass students, or to students meeting certain specific qualifications as stipulated by the donor of the scholarship in question. The awards and application procedure are described below. All such awards are handled by the Student Aid Office. Requests for information and applications for awards should be addressed to the Chairman of the Committee on Scholarships, Student Aid Office, Washington University, St. Louis 5, Missouri.

Awards Made to Freshmen

The awards made to freshmen entering directly from high school are four-year honor scholarships, one-year freshman awards, and certain of the special awards to which reference is made in the subsequent section entitled "Requirements for Restricted Funds."

Four-year Honor Scholarships, in the categories described below, are annually available to outstanding high-school graduates. In making such awards, the Committee on Scholarships recognizes students who give unusual promise of reflecting credit on themselves and the University after graduation. Character, leadership, and accomplishment are the

basic values sought. Announcements of awards is made at intervals in April and May.

National Honor Scholarships. Awards carrying full tuition and up to $500 a year, depending upon need, are available annually. The maximum value of each of these scholarships is $1,400 a year. Awards are made for four years, subject to annual review.

Full-Tuition Honor Scholarships. Four-year awards of full tuition ($900) each year are available annually. Some scholarships are reserved for graduates of Greater St. Louis and Kansas City high schools; others are awarded at large. Awards are subject to annual review.

Half-Tuition Honor Scholarships. Four-year awards of half tuition ($450) each year are made available annually. Awards are subject to annual review.

One-Year Freshman Scholarships. Awards are made in variable amounts and are for the freshman year only. Recipients may apply during the freshman year for upperclass awards for subsequent years.

Application Procedure

As stated above, application forms may be obtained from the Student Aid Office. Applicants for scholarships must also apply for admission. Scores are required from the College Entrance Examination Board Scholastic Aptitude Test, the fee for which is $7.00. Arrangements for taking the College Board examination may be made by writing to the College Entrance Examination Board, Box 592, Princeton, New Jersey, or Box 27896, Los Angeles 27, California. Applicants should ask that the scores be reported to the Office of Admissions. The preferred test dates are in December and January. Results from the February test may not be available for the competition for the first awards made. Students who meet special eligibility requirements for restricted funds (listed under the section entitled Requirements for Restricted Funds) should so signify on their applications.

Applications for scholarships are accepted from January 1 to March 1. All parts of the scholarship application, including admissions and test information, must be completed by March 1.

Awards Made to Upperclassmen

Awards made to upperclassmen are Upper Division Honor Scholarships, Merit Scholarships, General Scholarships, and certain of the sponsored scholarships listed in the subsequent section under that heading.

Upper Division Honor Scholarships. To provide for the needs of an increasing number of students transferring to Washington University after completing two years of work in junior colleges or other approved

institutions, a special category of upper division scholarships is provided. Approximately fifty awards are made in categories of full and half tuition. Awards are made for two years, subject to annual review.

Merit Scholarships. A small number of awards are made to recognize outstanding achievement and significant contribution to the Washington University community. To be eligible, a student must have been in residence at Washington University for at least one year and must not already hold an honor scholarship. The amount of these awards will be $200 unless the applicant submits the financial data regularly required in the general scholarship category so that a larger amount can be assigned if the need is more than the basic merit award.

General Scholarships. Awards are available to sophomores, juniors, and seniors. Scholastic records, recommendations, and financial need are considered in making awards. Amounts granted range from $50 to full tuition. Awards are made annually for a full academic year.

Application Procedure

Application forms for all upperclass scholarships are available at the Student Aid Office. Students transferring from other colleges or universities must also apply for admission. Any applicant having the special qualifications for a restricted fund (listed below) should note his qualifications on the application form. Verification papers will be required for LaVerne Noyes and Western Sanitary Commission applicants.

Filing dates for the various types of upperclass scholarships are:

Upper Division Honor Scholarships.....April 15
General and Merit Scholarships .....May 1

Announcement of Upper Division Honor Scholarship Awards is made in late May or early June; of General and Merit Scholarship Awards in late July or early August.

Requirements for Restricted Funds

A few of the University scholarship funds are limited to students in the following categories who also meet general scholarship standards. Applicants in these categories should so indicate on their application blanks.

Graduates of the Buder School in St. Louis.

Students from the Masonic Home of Missouri.

Children of Missouri Pacific Railroad employees.

Descendants of veterans of the First World War.

Descendants of Union soldiers who served in the Civil War.

Students from the State of Illinois.

Women preparing for a professional career.

Sons of employees of the Frisco Railway.

Male graduates of the St. Francois County, Mo., high schools.

Children of employees of the National Enameling and Stamping Company

Graduates of University City High School.

Graduates of public high schools in Red Bud, Illinois.

LOANS

University loan funds are available to full-time students enrolled in the University who have satisfactory academic records (except students in their first semester of residence at Washington University, freshmen, and students from abroad). Loans are designed to supplement the student's existing resources, and to enable students to use their greater earning power as graduates to meet part of their educational costs.

Loans are issued on notes payable normally in a five-year period after graduation. No interest is charged while the student is in school. A 3% annual charge is made on the unpaid balance after the student has received his degree or has left the University. A co-signer is required for the promissory note and may be a parent, guardian, or other responsible member of the family.

Application should be made at the Student Aid Office in the Student Activities Building at least ten days before the date the loan is needed.

The loan provisions of the new National Defense Education Act will operate through existing university loan programs and will essentially assure the adequacy of available funds. Loans made under this program will have a longer payment period and payments may be reduced by fifty per cent for those engaged in public school teaching. Full information regarding this program may be obtained at the Student Aid Office.

Deferred Tuition

Arrangements can be made through the Student Aid Office to pay the tuition of $450 a semester in four installments. The procedure for application and payment is explained in the section on Financial Regulations.

SCHOLARSHIP AND LOAN FUNDS

Funds for scholarship and loan awards are provided in part by the University and in part by the generosity of friends of the University who have established permanent endowments or continuing annual contributions for the benefit of Washington University students.

Grants in all cases are made under current University award standards. Assignment to particular funds is made in accordance with the preferences of donors. Such particular qualifications are summarized in the preceding section entitled "Requirements for Restricted Funds." Students with such qualifications should specify them in their scholarship applications.

Scholarship Funds

Blossom Scholarship. Bequest of Ada E. Blossom.

Lydia D. Buder Endowment Fund, for a scholarship to be awarded to a high-ranking graduate of each of the graduating classes of the Buder School in St. Louis, whose subsequent record in high school warrants conferment of such an award. Bequest.

Chandeysson Scholarship, in Electrical Engineering. Gift of the Chandeysson Electric Company.

Elizabeth Clark Scholarship Fund. Bequest of Elizabeth Clark, widow of Sanford Clark.

Class of 1903 Scholarship Endowment Fund. Established by contributions from members of the class.

Samuel Cupples Scholarships, preferably for graduates of the manual training course in the high schools of St. Louis. Gift of Samuel Cupples.

Frank Andrew Eliot Memorial Scholarship Fund, for graduates of St. Louis high schools.

William G. Eliot Scholarship. Established by gift of William G. Eliot, one of the founders of Washington University and its third Chancellor.

First National Bank in St. Louis Scholarship Endowment. Established by gift for scholarships in any school.

William C. Gotshall Engineering Scholarships. Bequest of Mr. Gotshall.

Kahn-Morris Scholarship. Established by gift of Mrs. Samuel T. Lipsitz, in memory of her father, Abraham Kahn, and her uncle and aunt, William and Clara Morris.

George Augustus Knight Memorial Fund. Established by gift of Brigadier General John G. D. Knight, A.B., 1864, in memory of his father.

Mary and Ike Levinson Scholarship Fund. A memorial to Mary and Ike Levinson provided by their children to support scholarships to students from the University City High School.

Ezra H. Linley Students' Aid Fund. Bequest of Ezra H. Linley.

Manual Training School Scholarships, preferably for young men who have taken the manual training course in the St. Louis high schools. Established through gifts of the following donors:

Gottlieb Conzelman
Samuel Cupples
Timothy G. Sellew
William Brown
William L. Huse
Emeline F. Rea
William A. Hargadine
Alumni
George W. Krall

Masonic Home of Missouri Scholarship, for a young man or woman from the Masonic Home of Missouri. Established as a memorial of the Grand Chapter Order of the Eastern Star of Missouri. Awarded by the Advisory Board of the Masonic Home to a candidate acceptable to the University.

Eliza McMillan Student Aid Fund, for women in various divisions of the University. Bequest.

Mercantile Library Scholarship, at the disposal of the Mercantile Library Association.

Missouri Pacific Lines Scholarship. Preference is given to employees or children of employees of the Missouri Pacific Lines. Established by the Missouri Pacific Railroad Company as a memorial of its Diamond Jubilee Pageant of Progress, presented on Francis Field, July 4-11, 1926.

LaVerne Noyes Scholarships, for persons who served in the Army or Navy of the United States in World War I, or their descendants. Established by the trustees of the estate of LaVerne Noyes.

Peifuss Memorial Scholarship Endowment. Bequest of George John Lischer as a memorial to his mother, aunt, and grandmother, Katherine Peifuss Lischer, Minnie Peifuss, and Henrietta Peifuss. The income is to be used for scholarships in any school.

Albert J. Plessner Fund. Established as a memorial by an anonymous donor.

Joseph H. Roblee Scholarship Endowment Fund. Established by gift of Florence A. Roblee in memory of her husband.

The St. Louis - San Francisco Railway Scholarship in Engineering. Preference is given to sons of Frisco employees, or if there are no qual-

ified applicants in this group, preference is given to students from states served by the Frisco Railway System. At present these are Missouri, Kansas, Oklahoma, Texas, Arkansas, Tennessee, Florida, Mississippi, and Alabama.

William Eliot Smith Memorial Fund. Preference is given to applicants from Illinois.

Hubert P. Taussig Fund.

Van Blarcom Scholarships. Bequest of Mary G. Van Blarcom.

Western Sanitary Commission Scholarships, for descendants of Union soldiers who served in the Civil War. Established in 1871, through a trust fund accepted by the University from the Western Sanitary Commission.

Loan Funds

Air Conditioning Council Loan Fund, to aid worthy engineering students.

Daniel and Blanche Bordley Loan Fund, for women. Established by gift of Mrs. Bordley.

Joe B. Butler Memorial Loan Fund, for juniors in any department of the School of Engineering. Established in memory of Joe B. Butler by the Missouri Society of Professional Engineers.

Robert S. Brookings Fund, for temporary financial assistance.

Jackson Johnson, Jr., Fund, for men. Established by Jackson Johnson in memory of his son, who lost his life in the service of the United States during the First World War.

David May Loan Fund. Bequest.

Washington University Student Loan and Scholarship Association, provides tuition loans for worthy students.

John Logan Yates Memorial Loan Fund, for third-year and fourth-year students. Established in memory of John Logan Yates, a member of the faculty of the School of Engineering.

Sponsored Scholarships

Some scholarships are placed with Washington University by certain outside agencies, companies, and foundations. These awards are made by the University through its regular channels and according to the standards for all regular scholarship awards. Awards are made available to students of the University in these categories and from the following sources:

Four-Year Awards

General Motors Corporation. One award annually, ranging from $200 to $2,000, depending upon need.

Procter and Gamble Foundation. Two awards annually. Tuition plus allowance for books and supplies.

Valley Dolomite Corporation. One award annually in an amount up to full tuition, depending upon need. For male graduates of St. Francois County, Missouri, high schools.

One-Year Awards

American Furnace Company Foundation. One award annually to a student entering the University after graduation from the public high school of Red Bud, Illinois. The amount of the award is made with the presumption of its continuance.

Fribourg Foundation. One or two awards annually. Tuition plus allowance for expenses, depending upon need.

The Mississippi Valley Structural Steel Company Scholarship provides financial assistance for undergraduate students majoring in Civil Engineering.

The Monsanto Chemical Company Scholarship in Engineering provides full tuition to an outstanding student majoring in Chemical Engineering.

The National Aniline Scholarship in Chemical Engineering of the Allied Chemical and Dye Corporation provides full tuition for a worthy undergraduate student with the stated intention of majoring in Chemical Engineering. The appointee should be a citizen of the United States.

Nesco Foundation. $500 a year, preference to children of Nesco employees in the Granite City Area.

Standard Oil Company of California. $750 a year, scholarship in Earth Science.

The White-Rodgers Electric Company Scholarship in Engineering provides tuition and an expense allowance for a worthy undergraduate student majoring in Mechanical, Electrical, or Industrial Engineering who has completed three years of work toward the bachelor's degree in one of these fields.

Corporation Awards to Children of Employees

An increasing number of companies have scholarship programs open to children of their employees. The University has a close relationship

to such plans. Some such awards are made through the University; others are made to the student and are then set up at the university of his choice. Inquiries about such plans should be made through the employing company.

PART-TIME EMPLOYMENT

Many students at Washington University supplement their financial resources through part-time employment. Assistance in securing such work during the school year as well as full-time jobs during the summer months is given by the Student Employment Office. This office lists campus as well as local and non-local employment opportunities. A staff is provided to give students effective help in finding employment and in working out their adjustments to employment. Students who desire to earn part of their expenses should register with the Student Employment Office as soon as their credentials have been approved by the Office of the Dean of Admissions. Every effort will then be made to notify them of opportunities for the work they want and are qualified to accept.

Although the Student Employment Office places and assists hundreds of Washington University students each year, it cannot guarantee in advance just what employment will be available for each student. Jobs generally have to be filled as quickly as possible after being referred to the office; the prospective employer invariably requests a personal interview; and the student's work abilities, together with his class schedule, will determine the jobs he is able to consider. Students are therefore advised to enter the University with sufficient funds to cover their tuition for the first year and most of their expenses for the first semester.

PRIZES

The Allison Fund, established by James E. Allison, has for its purpose the encouragement of the study of economics by students in the School of Engineering of Washington University. The annual income of this fund is to be used either for awarding cash prizes, or in such other manner as in the opinion of the Dean of the School of Engineering and the chairman of the Department of Economics may best promote the object of the fund. When a prize is offered, competition shall be open to the students of the School of Engineering who undertake a special investigation in the field of public utilities under the direction of the Department of Economics, with such restrictions as to eligibility as may be determined from time to time.

The American Society of Civil Engineers, St. Louis Section, offers an annual prize consisting of the entrance fee and first year's dues for junior membership in the American Society of Civil Engineers.

It is awarded to the outstanding senior in Civil Engineering of Washington University.

The Associate General Contractors of St. Louis offer an annual cash prize to the most worthy graduate in Architectural Engineering. The award is made by a committee consisting of the Deans of the Schools of Engineering and Architecture and the President of the Associated General Contractors.

A. H. Winheim Memorial Award. In 1950 the St. Louis Section of the American Chemical Society established an annual award in memory of Ade H. Winheim (B.S. in Chemical Engineering, 1927) in the form of a one-year membership in the American Chemical Society. The award will be made annually, in December, to the top-ranking student in Chemical Engineering at Washington University selected by the Department of Chemical Engineering. Membership in the American Chemical Society will become effective on January 1 of the year following. The number of annual awards to be made is at the discretion of the St. Louis Section of the American Chemical Society, but will not exceed twenty-five.

St. Louis Chapter American Institute of Industrial Engineers Outstanding Senior Student Award. A plaque on which the name of each year's outstanding senior is engraved has been donated by the St. Louis Chapter of the American Institute of Industrial Engineers. The senior so selected each year also receives a pocket slide rule suitably engraved. The student is selected by means of a three-part vote: by the Faculty of the Department of Industrial Engineering, by the members of the Washington University student chapter of the American Institute of Industrial Engineers, and by the members of the Senior Class in Industrial Engineering. The award is made on the basis of all-round University and extracurricular activities as well as academic scholarship. The student must have a 2.0 grade-point average or better.

St. Louis Society for Quality Control Prize. The St. Louis Section of the American Society for Quality Control offers an annual cash prize of $50 to the senior Industrial Engineering student submitting the best paper on Statistical Quality Control or on the application of Statistical Quality Control techniques to other problems in Industrial Engineering, as part of the Statistical Quality Control Course.

The American Institute of Chemical Engineers makes an annual award of an honor plaque and membership pin to the junior Chemical Engineer at Washington University who has earned the best academic record during the first two years of his program of study in Chemical Engineering at Washington University.

The E. O. Sweetser Award was established in honor of Professor E. O. Sweetser, who served the University from 1905 until the time of his death in 1951. Friends and former students have made a fund available for a cash award to a graduating senior in Civil Engineering as selected by the staff in Civil Engineering.

DORMITORIES

The dormitories provide modern living facilities for 840 students. All dormitory buildings are on the campus close to the center of both the academic and the co-curricular programs of the University. New buildings are under construction in an expansion plan that will eventually provide housing for between 1,500 and 2,000 students in campus dormitories.

Students may request the reservation of living accommodations in the campus dormitories when they have been accepted by the Office of Admissions. It is to be noted, however, that acceptance by the Office of Admissions does not in itself constitute the reservation of a dormitory room. Requests for application forms for rooms in the dormitories should be made to the Director of Dormitories, Washington University, St. Louis 5, Missouri. Assignment of a room to the student is made with the understanding that the student agrees to occupy the room for the academic year.

All undergraduate women not living with their families are required to live in the dormitories. An exception will be made upon written request by the student's parents or guardian and at the discretion of the Director of Dormitories.

Forsyth Dormitories

The Forsyth Dormitories are new and will be ready for occupancy in September, 1959. They are planned so as to furnish optimum facilities for comfortable living and an atmosphere conducive to effective study. Each building is divided into three sections, with a graduate resident in each section who will work with the students on current problems and dormitory program. Rooms are provided for 288 men and 288 women on a two-to-a-room basis.

Each student is provided with a bed, desk, chair, chest of drawers, and a medicine cabinet with light. The rooms are equipped for controlled ventilation, heating, and cooling. The windows are large and are furnished with draperies. Students will furnish study lamps, waste baskets, ash trays, blankets, and bed spread.

The cost of living in the Forsyth dormitories is $800 for the year, half of which is due at registration each semester. This fee includes

room rent, twenty meals a week, maid service one day a week, clean sheets, pillow slip, and towels each week, and a private telephone in each room. Students may occupy their rooms from a date five days prior to the first day of registration in the fall to one day after their last final examination. Meals are furnished during this term of residence with the exception of the Christmas and Spring Recesses. During these recess periods meals will be available on a pay-as-you-go basis at a place to be announced.

McMillan Hall for Men

At the discretion of the Director of Dormitories, and in consideration of specific requests, men graduate students and men students over twenty-one years of age will be housed in McMillan Hall. This building will furnish generally the same services as those indicated for the Forsyth Dormitories. The rooms vary in size and will accommodate from one to three students. Students will furnish curtains or draperies for the windows in their rooms. Telephone service is provided through the Dormitory Office and a buzzer system. Private phones in the rooms are optional and are not included in the charge for the room. The cost of living is $300 for the year, half of which is due the first day of registration each semester. This fee includes room rent, maid service one day a week, a blanket, and clean sheets, pillow slip, and towels once a week. Meals are available in the McMillan cafeteria. Students may occupy their rooms from a date five days prior to the first day of registration in the fall to one day after their last final examination.

Lee Hall for Women

Lee Hall provides single, double, and triple rooms for 86 students. Located near the center of the campus, it provides excellent accommodations in a quiet atmosphere. At the discretion of the Director of Dormitories, women graduate students and women students over twenty-one will be assigned to live here. The charge for living in Lee Hall is $650 a year, half of which is due the first day of registration each semester. This fee includes room rent, meals, maid service one day a week, a blanket and clean sheets, pillow slip, and towels once a week. Each student is provided a bed, table, chairs, book shelf, and a chest of drawers. The student must provide her own study lamp and may bring any miscellaneous items of furniture she wishes to use. Meals are served in McMillan Hall Cafeteria on the following schedule: Week days, morning and evening meals; Sundays, morning and noon meals. Students may occupy their rooms from a date five days prior to the first day of registration in the fall to one day after their last final examination.

PAYMENT OF DORMITORY FEES

Payment of one-half the annual cost of living in a dormitory is due the first day of registration each semester. A $25 deposit must accompany each application for a dormitory room. This deposit is applicable to the total charge, but is forfeited if cancellation of a reservation is received after August 15 (or January 15 for the second semester). A $10 damage deposit, which is due at the time of occupancy, is refundable, less assessments, on termination of residence.

A deferred payment plan for dormitory living costs for the academic year 1959-60 is offered to those students who apply for this type of service. The payment schedule under this plan is as follows:

Fall Semester	*Forsyth*	*McMillan*	*Lee*
With application	$ 25.00	$25.00	$ 25.00
On arrival (but not later than registration)	140.00[1]	65.00[1]	125.00[1]
November 1	100.00	50.00	75.00
December 1	100.00	25.00	75.00
January 1	50.00		40.00
Spring Semester			
Registration	155.00[2]	80.00[2]	140.00[2]
March 1	100.00	50.00	75.00
April 1	100.00	25.00	75.00
May 1	50.00		40.00

[1] Includes $10 damage deposit and $5 fee for deferred payment.
[2] Includes $5 fee for deferred payment.

STUDENT COUNSELING SERVICE

The Student Counseling Service provides psychological testing and counseling services free of charge to students admitted or enrolled at Washington University and to prospective students who have already applied for admission.

The function of the Student Counseling Service is to offer assistance to the individual student desiring help with problems related to choice of vocational goal, academic performance, and general adjustment.

The office of the Student Counseling Service in the Student Activities Building is open Monday through Saturday mornings from nine o'clock to noon, and Monday through Friday afternoons from one to five o'clock. Students may make appointments through the receptionist by telephone, mail, or in person.

UNIVERSITY HEALTH SERVICE

Services

The Washington University Health Service, located in Lee Hall, affords immediate care and brief courses of treatment, without charge, during such health emergencies as may arise while a student is in attendance at the University. Students are encouraged to avail themselves of the facilities of the Health Service at all times as the need arises. Medicines prescribed by the attending physicians and surgeons, all of whom are members of the staff of the Washington University School of Medicine, are provided at cost. Physicians are available for emergency medical and surgical care twenty-four hours a day. Any student who requires more extensive treatment than that available at the Health Service will be referred to the physician of his choice, or if he desires, to a member of the staff of the Washington University School of Medicine. Families will be notified promptly of any acute condition requiring hospitalization. The costs of medicines, X-rays, and hospitalization are not borne by the University Health Service.

Medical Examinations

A medical examination by the student's physician is required of all students in the following categories:

1. All undergraduate and graduate students carrying seven or more units.
2. All students whose attendance at the University has been interrupted by an absence of at least one year.
3. All students whose home or legal address is outside continental United States who are attending the University for the first time or whose attendance has been interrupted by an absence of one or more years. This pertains to both undergraduate and graduate students, regardless of academic load.

A chest X-ray is strongly recommended as part of the medical examination.

A University Health Questionnaire, completely filled out, must be returned to the Health Service at the earliest possible time, and not later than two weeks before registration. Responsibility for fulfillment of this requirement rests with the student. Students failing to send in the questionnaire with completed physical examination prior to registration will be required to have the examination done at the Health Service and will be assessed the cost of the examination plus a late fee of $3.00.

Participation in Physical Education and Athletics

Any student who for medical reasons requires or desires an excuse from or modification of his program of Physical Education should report in person to the Director of the Health Service with the necessary data concerning his disability in the form of a letter from his physician. The Director will then make pertinent recommendations to the Dean and the department involved.

Any student wishing to engage in either intercollegiate or intramural sports must apply to the Health Service for a certificate that he is capable of participating without undue risk to himself. This certification is based primarily on the student's initial physical examination and must be renewed annually.

Health Protection for Students Not Living at Home

In all cases where students' families will be handicapped by distance or national barriers in assuming responsibility for medical care beyond the emergency coverage of the University Health Service, adequate provision for such protection must be made prior to enrollment.

Specifically, all students whose home address is outside metropolitan St. Louis and who carry seven or more units of academic work, and all students whose home or legal address is outside continental United States, regardless of academic load, are required to carry the Washington University Health Insurance Plan or to present evidence that they have equivalent coverage.

Washington University Student Health Insurance Plan

The University makes available through the Health Service a medical expense insurance plan which offers the protection required for all non-St. Louis students, and is available to all other full-time students as well. The plan is a liberal one and provides for reimbursement of the essential inpatient and outpatient medical services in the event of serious illness or injury. These services include hospitalization, laboratory examinations, X-rays, physician's and surgeon's care, etc. A detailed description of the plan is included in the pamphlet describing the Health Service which is given to all students with the registration materials and is available on request at the Health Service.

The cost of this plan is not included in the tuition fee, but is paid at the time of payment of fees. The fee may vary slightly from year to year depending upon insurance experience. It was $9.00 for the academic year 1958-59 for full twelve-month coverage. Payment is made at registration for the entire year. The student is protected by the insurance from the first day of registration for the ensuing calendar year.

Coverage is effective not only while the student is at the University but also while at home and while traveling in this country and abroad. In the event of withdrawal from the University, except by graduation, the contract is automatically cancelled and a pro rata refund will be made upon request.

During the fall registration period all full-time students of Washington University are eligible to enroll in this plan. During the first and second semesters they may enroll at the Health Service office.

Benefits are paid in addition to any to which a student may be entitled through membership in any other insurance plan.

This plan, combined with the facilities of the Health Service, forms a co-ordinated health program which will function to protect the student's health, especially if he is away from home, and will provide for his well-being in such a way as to further his best adjustment to his university life and program.

EXTRACURRICULAR ACTIVITIES

The faculty of the School of Engineering recognizes the value of extracurricular activities. Every student whose standing in scholarship is above question is encouraged to participate in one or more of such activities. To safeguard against excessive participation the following rules have been established:

1. Students on academic probation shall be eligible to take part in student activities or the public performances connected therewith only with the consent of the Dean of the School of Engineering.

2. No student on disciplinary probation shall be eligible to take part in student activities or the public performances connected therewith.

3. The eligibility of students admitted to advanced standing from another educational institution shall be determined by the Dean of the School of Engineering.

4. The eligibility of students not candidates for degrees shall be determined by the Dean of the School of Engineering.

Nearly every kind of extracurricular activity is represented on the campus. For students interested in dramatics, music, or debating there are such organizations as Thyrsus, which each year produces a number of plays; the Quadrangle Club, which annually stages a musical comedy; a marching and concert Band; the University Choir; the Men's Glee Club; the University Instrumental and Chamber Music Ensembles; the University Chamber Orchestra; and various debating activities sponsored by the Division of Speech of the English Department. In journalism there are such publications as *Student Life,* the semi-weekly campus

newspaper, and *Hatchet,* the yearbook. In sports there are both intramural and intercollegiate teams in such activities as swimming, tennis, golf, basketball, and football. The University YMCA-YWCA offers experience in social welfare and nonsectarian areas. Outstanding service and leadership are recognized by honorary societies such as Freshman Commission, Lock and Chain, Chimes, Thurtene, Mortar Board, and Omicron Delta Kappa. Supervising and co-ordinating all the many extracurricular activities is Student Senate, the student governing body.

Student chapters of the American Society of Civil Engineers, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers present professional programs at regular campus meetings. Engineering students become eligible for membership in these professional organizations during their sophomore year.

Extracurricular activities peculiar to the School of Engineering are supervised by the Engineers' Council. Two of these activities are Engineers' Day, held on St. Patrick's Day; and Engineers' Masque, the spring dance.

FACILITIES FOR STUDENT LIFE AND ACTIVITIES

Women's Building

The Women's Building, which was formally opened in 1928, is the center of the social life of the women of Washington University. It was erected through donations from nearly twelve hundred students, alumnae, and friends of the University.

Situated adjacent to McMillan Hall, the Women's Building is of the same Tudor Gothic type of architecture as the other University buildings. A large drawing room, alumnae room, reading room, rest room, gymnasium, and offices for the Dean of Women and the Division of Physical Education for Women comprise the main floor. The second-floor and third-floor rooms are used as clubrooms by sororities and other women's organizations. A well-appointed cafeteria, kitchen, and locker rooms occupy the ground floor.

Student Activities Building

Most of the student's extracurricular life centers in the Student Activities Building. The semipermanent structure, surrounded by attractive landscaping, is of low, rambling, modernistic design. It is conveniently located between McMillan Hall dormitory and Fraternity Row.

The building houses *Student Life,* campus newspaper; *Hatchet,* yearbook; the Debate Council; the Student Publications Bureau; Thyrsus, dramatic society; Quadrangle Club, musical comedy organization; and Student Senate. There is also a large meeting room which opens onto

a terrace. In addition, the building contains the offices of the Dean of Students, including the Student Aid Office, which handles the scholarships, loans, and part-time student employment; and the Counseling Service.

PHYSICAL EDUCATION

Four units of Physical Education, Air Science, Military Science, or Band are required of all men students who are candidates for degrees. Physically handicapped students are directed into activities in keeping with their physical ability or may be excused from this requirement at the discretion of the Director of the University Health Service.

Four units of Physical Education or Band are required of all women students who are candidates for degrees. Body mechanics, social recreation, and an elective program in sports, dance, and aquatic activities are included in this requirement. Physically handicapped students are directed into activities in keeping with their physical ability, or may be excused from this requirement at the discretion of the Director of the University Health Service.

An extensive intramural program for both men and women offers broad opportunities for student participation and leadership in games and contests.

An opportunity to participate in intercollegiate athletics is provided every student who is in good physical condition and whose scholastic record is satisfactory. The Faculty Committee on Athletics is the governing body for the administration of these activities. Washington University is a member of the National Collegiate Athletic Association and the National Federation of College Women.

Splendid facilities are available for the conduct of the total program of the Department. The David R. Francis Gymnasium contains the locker and shower rooms for athletics and the facilities essential to the conduct of the required Physical Education program. The Field House, which has a seating capacity of more than six thousand, is used for physical education classes, intramural and recreational activities, and intercollegiate basketball.

Indoor facilities for women include a gymnasium, equipped with showers and lockers, located in the Women's Building.

Wilson Swimming Pool adjoins Francis Gymnasium and is designed for instructional, recreational, and exhibition swimming. It has showers and locker rooms for both men and women.

Football and track and field events are conducted on Francis Field. The stadium has a seating capacity of approximately eleven thousand.

Baseball contests are held on Liggett Field, which adjoins Francis

Field. Additional facilities include football, softball, and hockey fields, and ten hard-surface tennis courts.

MILITARY TRAINING

The Department of Army and Air Science at Washington University is composed of an Army unit, known as the Reserve Officers' Training Corps—Army ROTC, and an Air Force unit, known as the Air Force Reserve Officers' Training Corps—AF ROTC.

Male students entering the University may enroll in either officers' training unit and, under certain conditions, postpone their military service until graduation. Within the quota limitations established by the Department of Defense, students at Washington University are able to take the military program of their choice and compete for deferment from training and service under the Selective Service Extension Act of 1950. Those who complete the work in the Army ROTC will receive reserve commissions in the Army, and those who complete the work in the AF ROTC will receive reserve commissions in the Air Force.

Four units of Air Science or Military Science, Physical Education, or Band are required of all men students who are candidates for degrees. Students who wish to qualify for reserve commissions in military units must elect either the Army unit or the Air Force unit during their freshman year, since these are four-year programs. Exceptions will be made for veterans and transfer students who have completed work in a military unit elsewhere.

To male students in the University, if they are regularly enrolled students in good standing, if they have passed the required physical examinations, and if they are American citizens, the Department of Army and Air Science offers training designed to develop mental and physical alertness. Such training stresses loyalty and respect for constituted authority and provides opportunity for the development of leadership.

Uniforms are furnished to basic students and an allowance is made to the University for the purchase of a complete officer's uniform for each student in the advanced courses. Students enrolled in the advanced courses receive $27.00 per month for a period not to exceed nineteen months. They must attend one summer camp of six weeks duration in the case of Army ROTC, four weeks for Air Force ROTC, at $78.00 per month, normally following their junior year, and they may compete for a regular commission. Students in the advanced courses are chosen on a competitive basis from those who have completed the basic courses or their equivalent.

UNIVERSITY BAND

Qualified students may substitute participation in the activities of the University Band for the required Physical Education, Air Science, or Military Science under the following regulations:

1. Four units may be granted in all, one for each semester in what would normally be the freshman and sophomore years.

2. Credit will be allowed only when, at the end of each semester, the Director of the Band certifies to the Office of the Dean that the student has regularly attended the weekly rehearsals, and regularly attended, as a member of the Band, all University functions in which the organization usually takes part.

Students interested in receiving credit for Band participation should report to the Director of the Band for an audition prior to registration. The University Band is a highly disciplined organization which trains students in carriage, rhythm, teamwork, precision, co-ordination of mind and muscle, and organization spirit. Its annual performances include field work at football games, both at home and away, programs at basketball games, and a concert schedule. Excellent uniforms are supplied, as well as Band-owned instruments.

LIBRARIES

The table shown below gives the number of books in the libraries of Washington University. More than 10,500 serials are currently received by purchase, deposit, or exchange.

Library	*Catalogued Volumes June 30, 1958*
Main Campus	
Central Library (Ridgley)	353,242
Art and Architecture	14,574
Art	4,981
Biology	13,734
Business	12,805
Chemistry	7,670
Engineering	48,381
Geology	13,319
Law	82,632
Music	17,935
Physics	7,269
Social Work	16,017
Total	592,559
Medical Campus	
Dentistry	9,744
Medicine	82,308
Nursing	2,906
Total	94,958
Grand Total	687,517

A student of the University who wishes to draw books from libraries on the main campus must secure a personal library card. The student may obtain this card without charge at the Circulation Desk in Ridgley Library by presenting a receipt for tuition in any division of the University for the current semester. This card will be honored at all libraries on the main campus. A former student may secure a library card good for one term upon payment of a fee of $1.00.

The General Library occupies the Ridgley Library building. The library is a partial depository of United States Government Documents and receives on exchange the publications of a large number of American and foreign institutions and learned societies.

The library has working collections, including complete files of many of the more important American and foreign periodicals, in all of the fields represented in the College of Liberal Arts, together with a large and growing collection of works of general reference. Especially notable are the Preetorius Memorial Collection of 12,000 volumes on the German language and literature, the W. K. Bixby Collection of rare books, the Max W. Bryant Collection of rare books on Romance languages, the John M. Wulfing Collection of Numismatics, and the Bryce and Link Collections of works on architecture.

The books and periodicals assigned to the School of Architecture, Business and Public Administration, Engineering, Fine Arts, Law, and Social Work, and to the Departments of Art and Archaeology, Biology, Chemistry, Geography and Geology, Music, Physics, and Sociology and Anthropology are placed in special libraries in the buildings of the respective schools and departments.

School of Engineering

The library of the School of Engineering is located on the second floor of the Henry Edwin Sever Memorial Hall. This new library now includes all the engineering materials formerly housed in departmental libraries, as well as the entire mathematics and astronomy library collections. There is stack space for about 30,000 volumes. The main reading room has a seating capacity of eighty-four, and the graduate study carrells will accommodate an additional thirty graduate students. This library also is the center for photographic reproductions, with complete equipment for microfilm, photostat, and photographic printing. Another unique feature is the browsing room, where a general collection of recreational and informational literature has been placed so that the engineer can enjoy fields of culture beyond engineering.

Other Library Facilities

The St. Louis Public Library comprises 1,092,755 volumes (including duplicates) and 1,007,315 pamphlets. It is a well-balanced general reference library, and its collections in the fields of art, English and American literature, history, economics, government, and applied science are especially valuable. It is well equipped with federal and state public documents and is one of the few libraries in this country receiving the German patents. About 3,900 different periodicals are currently received. The Steedman Architectural Collection, in a separate room, may be consulted by those who apply for cards of admissions.

The Municipal Reference Library, 410 City Hall, is a branch of the Public Library. It has a collection of over 8,000 bound volumes, approximately 8,000 pamphlets, and 240 periodicals on city government and related fields and a vertical file of pamphlets and newspaper clippings on local and state government.

The St. Louis Mercantile Library comprises about 220,000 volumes, receives newspapers from the principal cities of the United States and from various foreign cities and subscribes to about 300 periodicals. It has an unusually rich collection of books relating to the history of the Middle West and is also well equipped in English history and in the local history of New England and the South. It has a good collection of bound periodicals relating to chemistry. Through the liberality of a number of citizens of St. Louis ninety-two memberships in the Mercantile Library have been placed at the disposal of the University. The use of these memberships is extended, under prescribed conditions, to such members of the University as may be designated by the Chancellor.

The Library of the Missouri Historical Society is historical and genealogical, containing the largest collection of Missouriana in existence as well as one of the largest collections of Jeffersoniana. In addition to these, special efforts are made to collect books on early western travels, the Mississippi Valley, the Louisiana Territory, and family histories. With its vast amount of manuscript materials and newspapers, the library is considered one of the most valuable of its kind in America. The library occupies the second floor of the east wing of the Jefferson Memorial, Forest Park, and is for reference only. It contains between 80,000 and 90,000 titles.

UNIVERSITY STORES

A store, the Quad Shop, which is under the control of the University authorities, carries a full line of books and materials. This store is located on the ground floor of the south wing of Robert S. Brookings Hall. There is a similar store for medical and dental students located in the School of Medicine.

POST OFFICE

Station No. 24 of the St. Louis Post Office is located in Room 29, Robert S. Brookings Hall, and transacts all the customary business of such stations. Mail is received three times a day (except holidays and Sundays) from the St. Louis Post Office. Lock boxes are available for students who desire to rent them.

SUMMARY OF ENROLLMENT

November 1, 1958

Seniors	267
Juniors	276
Sophomores	255
Freshmen	262
Students not candidates for a degree	2
	1,062

DEGREES CONFERRED

1957-58

Bachelor of Science	179
Total number of degrees conferred	4,369

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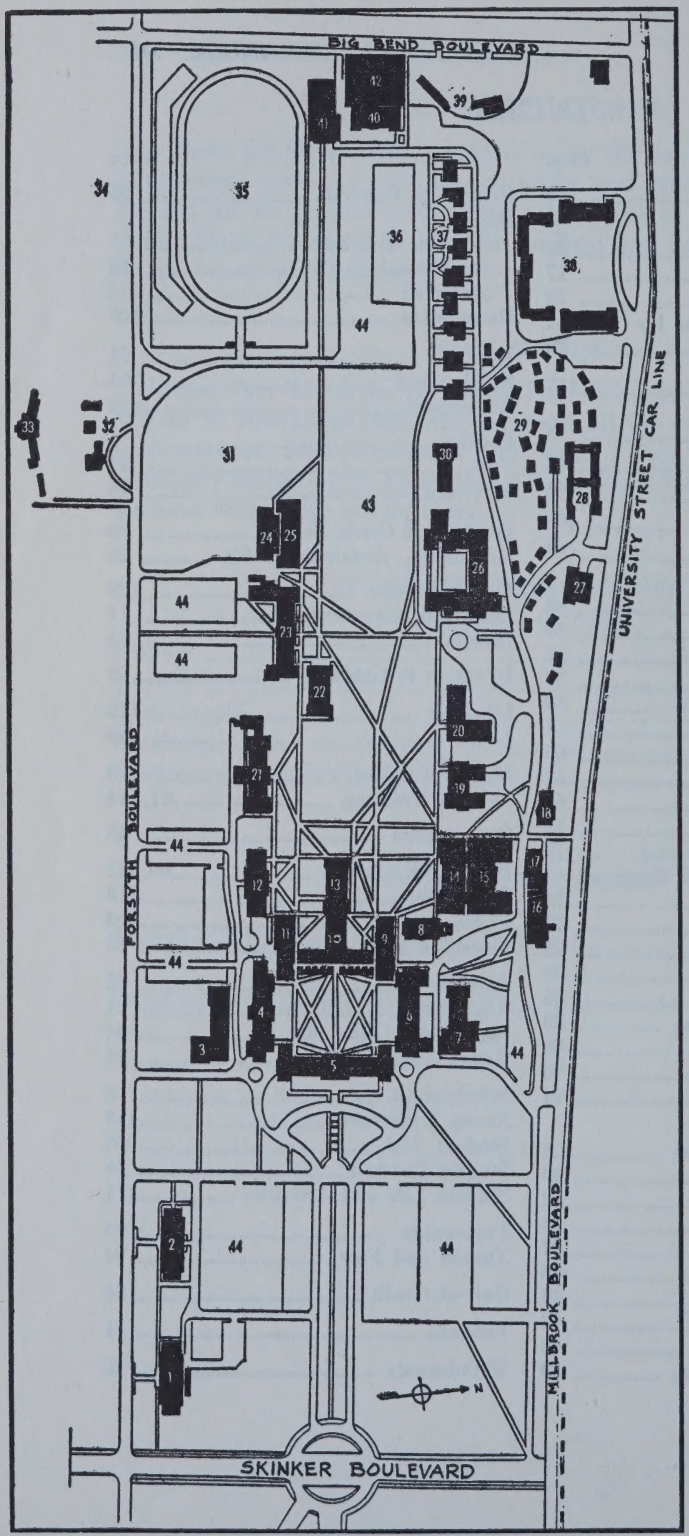

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THE SCHOOL OF LAW—Milton D. Green, A.B., J.D., LL.M., Jur.Sc.D., Dean

Three-year curriculum leading to the degree of Bachelor of Laws.

THE SCHOOL OF MEDICINE—Edward W. Dempsey, Ph.D., Dean
(660 South Kingshighway, St. Louis 10, Mo.)

Four-year curriculum leading to the degree of Doctor of Medicine; postgraduate courses. Through the Division of Auxiliary Medical Services, instruction leading to the degrees of Master of Hospital Administration, Bachelor of Science in Occupational Therapy, and Bachelor of Science in Physical Therapy; a course in X-Ray Technology leading to a certificate; in co-operation with Barnes Hospital, courses for Laboratory Technicians, Medical Dietitians, and Nurse Anesthetists leading to certificates.

THE SCHOOL OF DENTISTRY—Leroy R. Boling, Ph.D., Dean
(4559 Scott Avenue, St. Louis 10, Mo.)

Four-year curriculum leading to the degree of Doctor of Dental Surgery, and courses for graduate students who may or may not be candidates for the degree of Master of Science in one of the dental specialties.

THE SCHOOL OF NURSING—Louise Knapp, R.N., B.S., A.M., Director
(416 South Kingshighway, St. Louis 10, Mo.)

Advanced programs for graduate nurses leading to the degrees of Bachelor of Science and Master of Science in Nursing.

THE SCHOOL OF FINE ARTS—Kenneth E. Hudson, B.F.A., Dean

Specialized four-year programs leading to the Certificate of Attainment or the degree of Bachelor of Fine Arts, in Painting, Sculpture, Illustration, Advertising Design, Fashion Illustration, Dress Design, Crafts, and Art Teacher Education.

UNIVERSITY COLLEGE—Earnest Brandenburg, Ph.D., Dean

An adult education and evening division offering a wide range of classes for students who are unable to attend during the day, including courses which lead to the degrees of Bachelor of Science and Bachelor of Science in Education.

THE SUMMER SCHOOL—Adolph Unruh, Ph.D., Director

Courses from almost every division of the University, under the regular teaching staff, as well as special classes given by instructors who are invited to the campus for this purpose.

THE GRADUATE SCHOOL OF ARTS AND SCIENCES

Lewis E. Hahn, Ph.D., Dean

Graduate Institute of Education—Robert J. Schaefer, Ph.D., Director

Work leading to the degrees of Master of Arts and Doctor of Philosophy; graduate professional degrees of Master of Science in Health and Physical Education, Master of Science in Counseling and Personnel, Master of Science in Speech and Hearing, and Master of Music. Through the Graduate Institute of Education, graduate professional degrees of Master of Arts in Education and Doctor of Education; and the Advanced Graduate Certificate in Education.

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